FOUNDRY TRADE JOURNAL

EST. 1902

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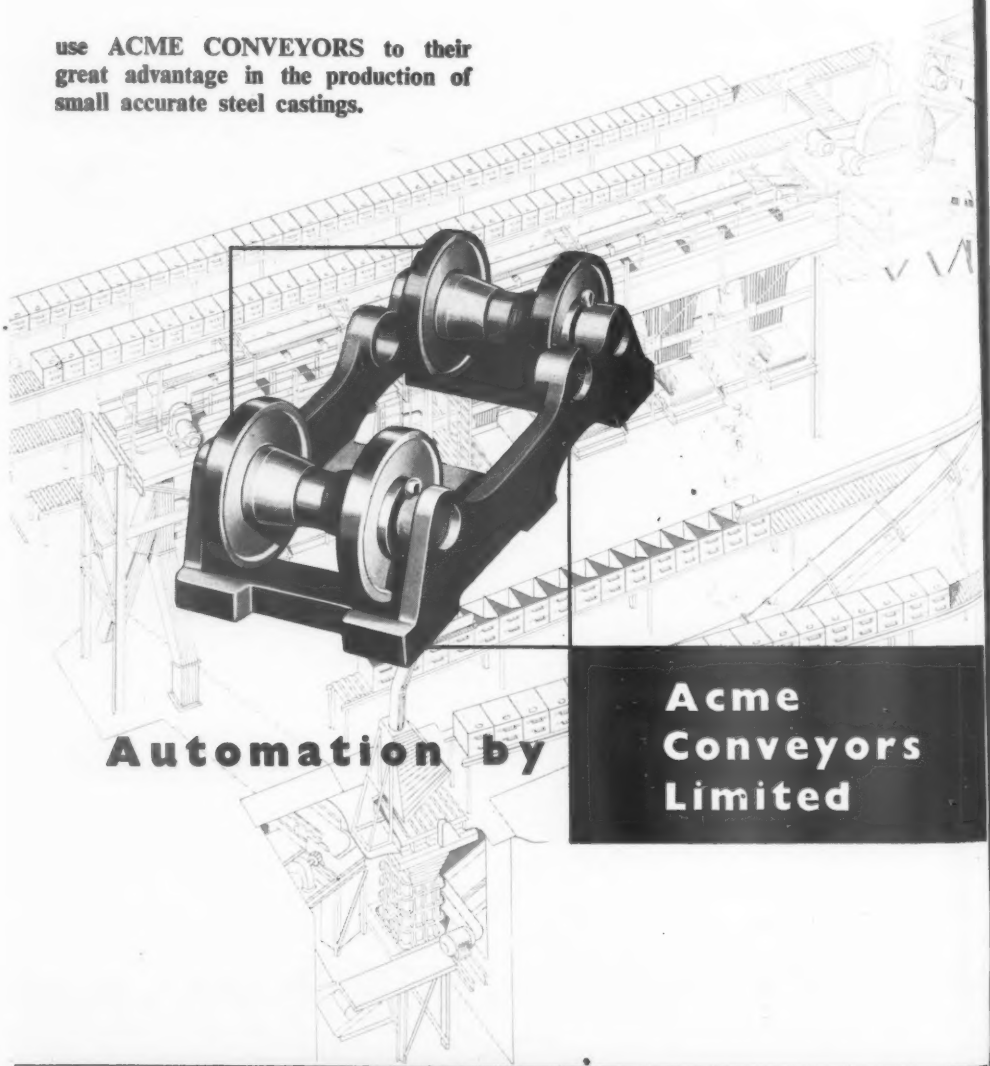

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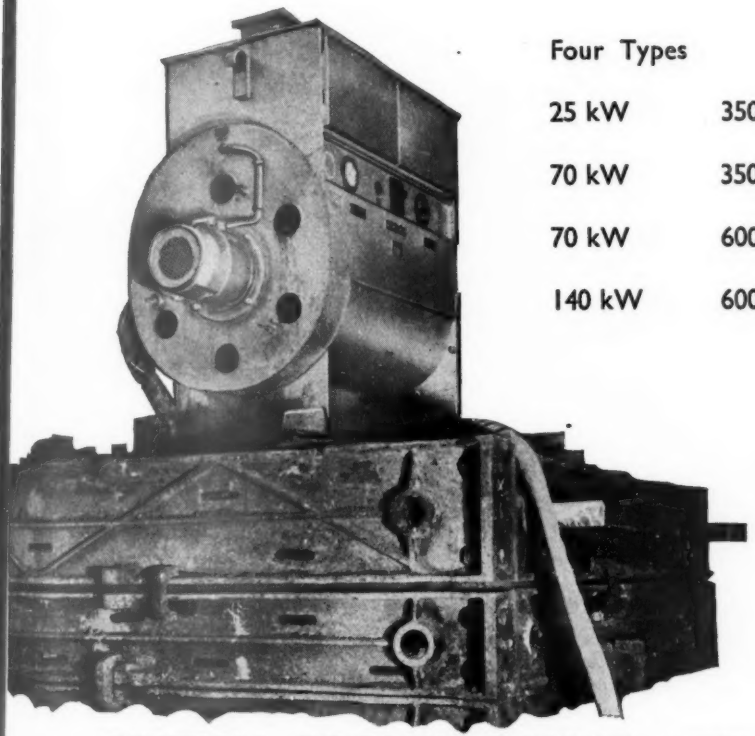

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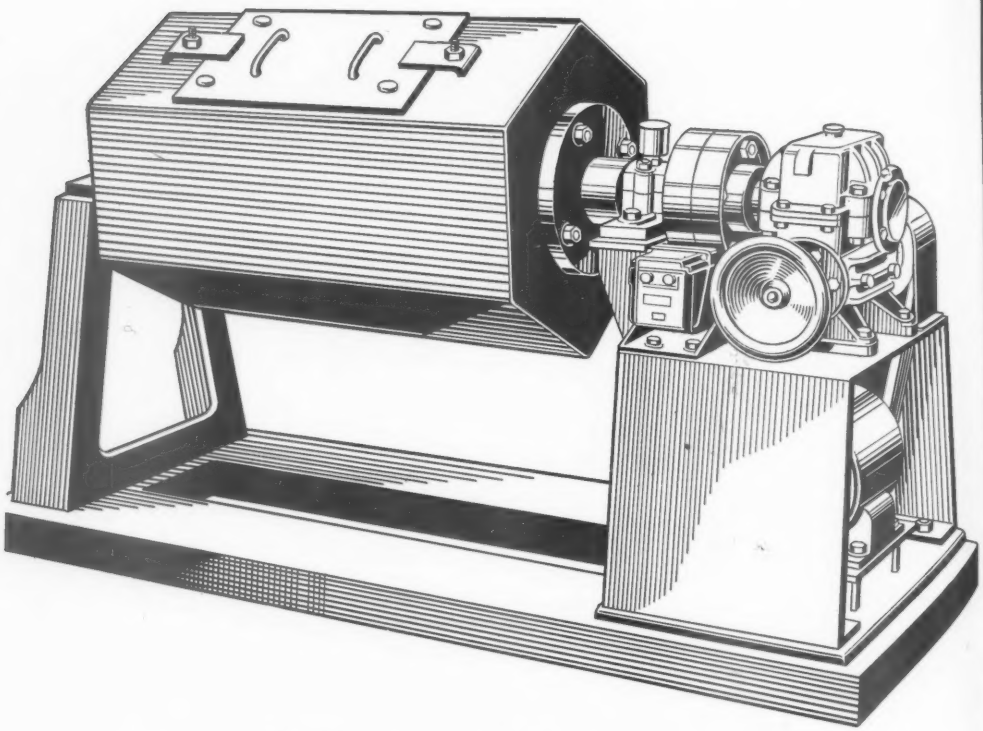

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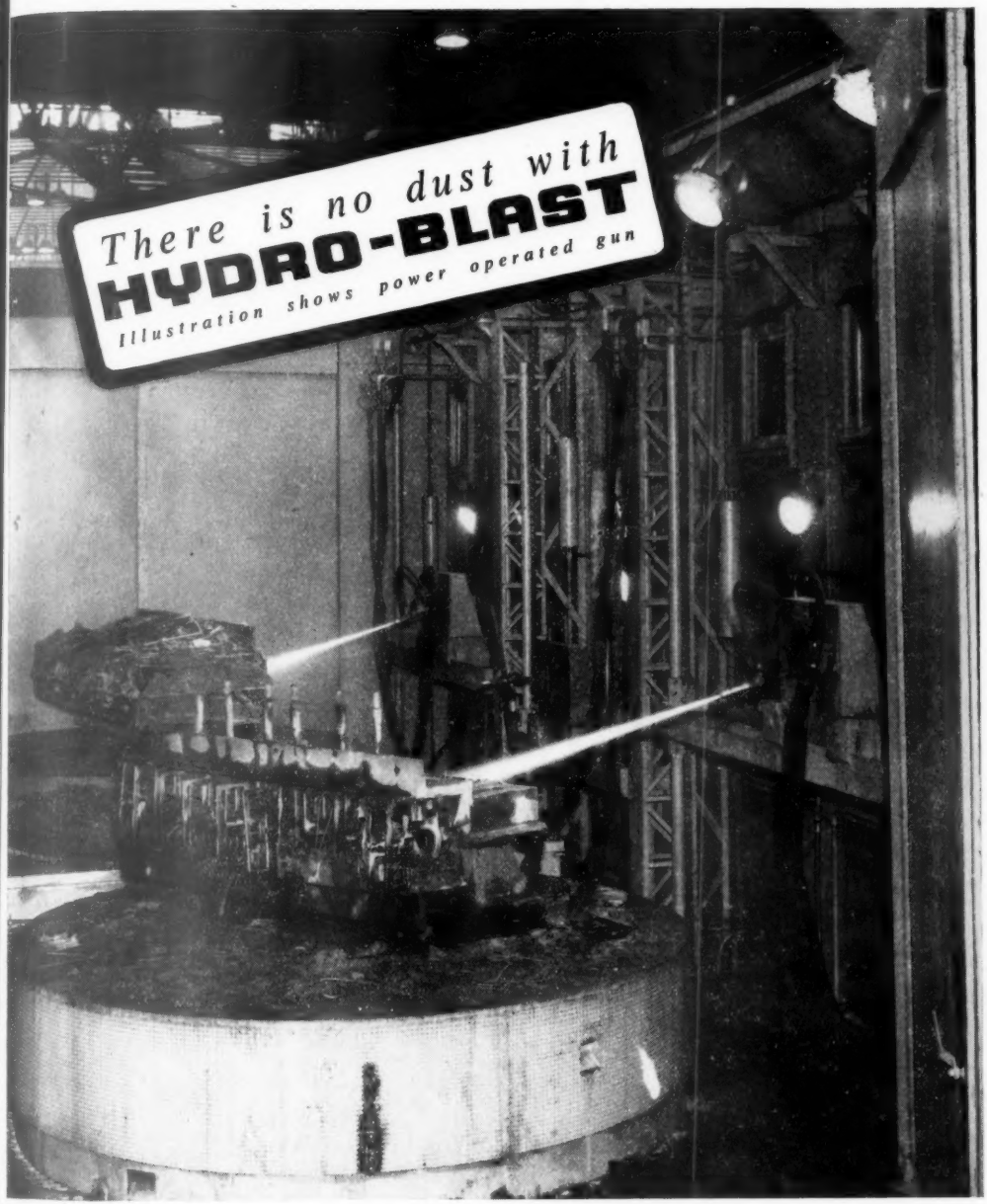

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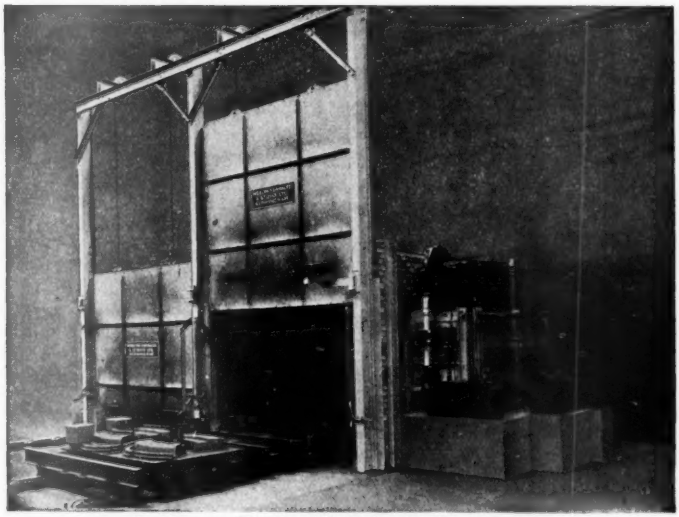

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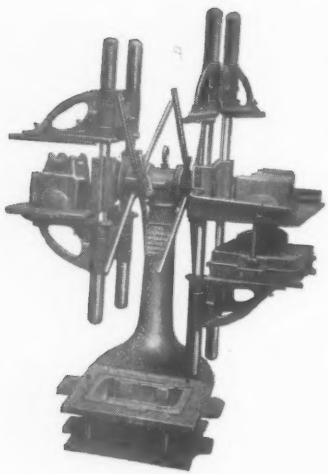

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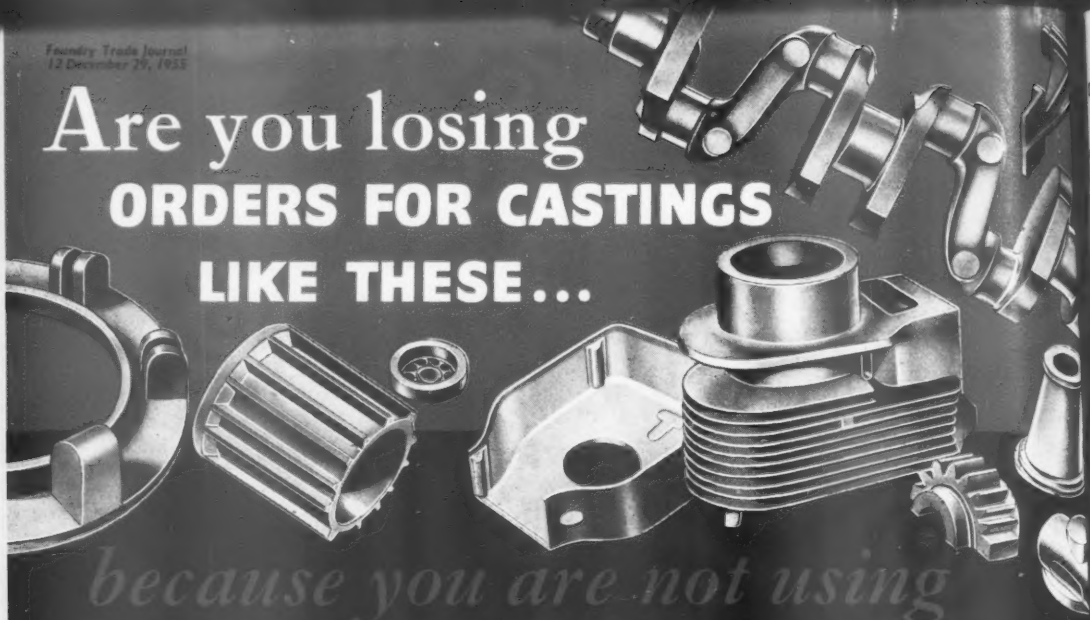

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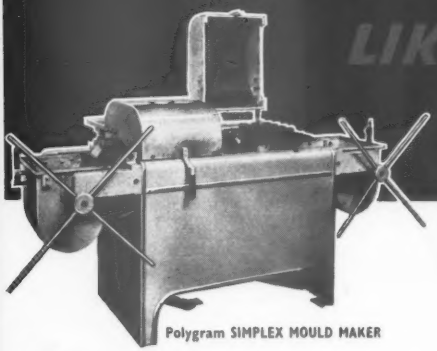

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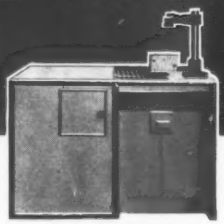

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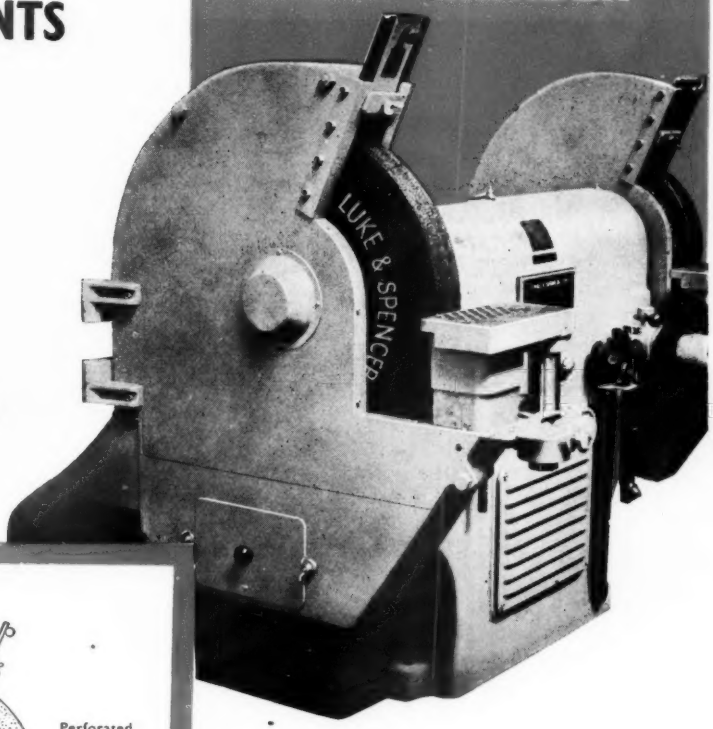

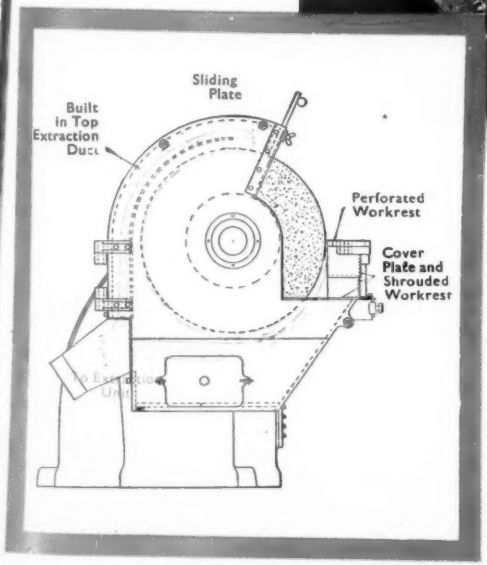

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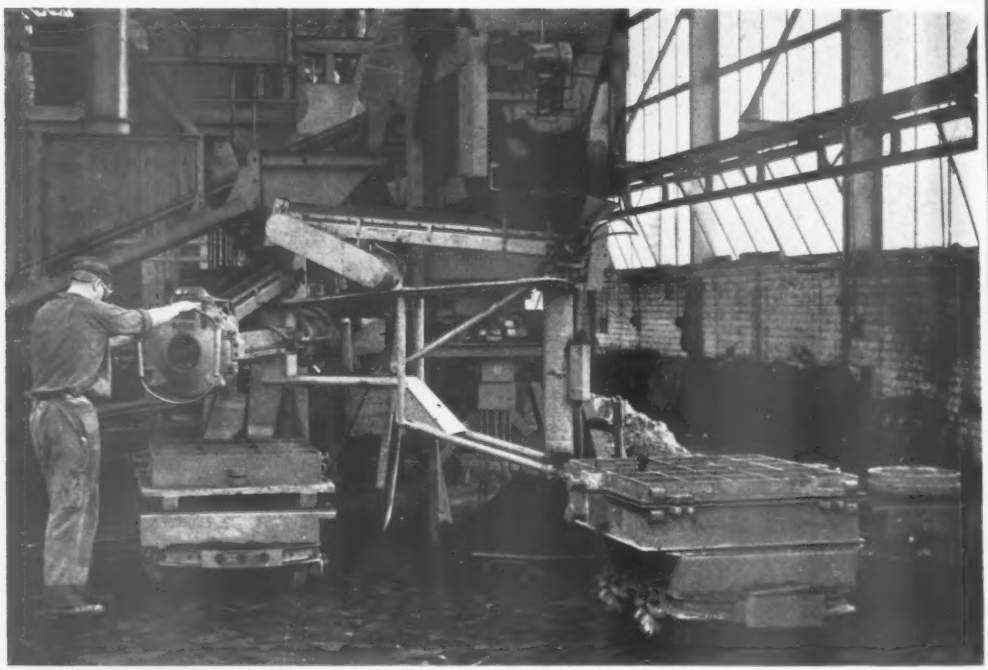

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Photos show No. 1 'Senior' and 'Major' machines.

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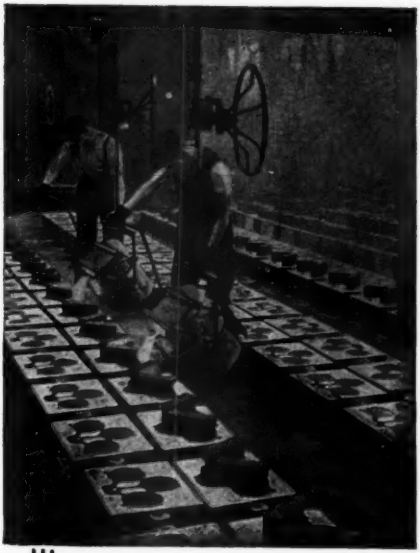

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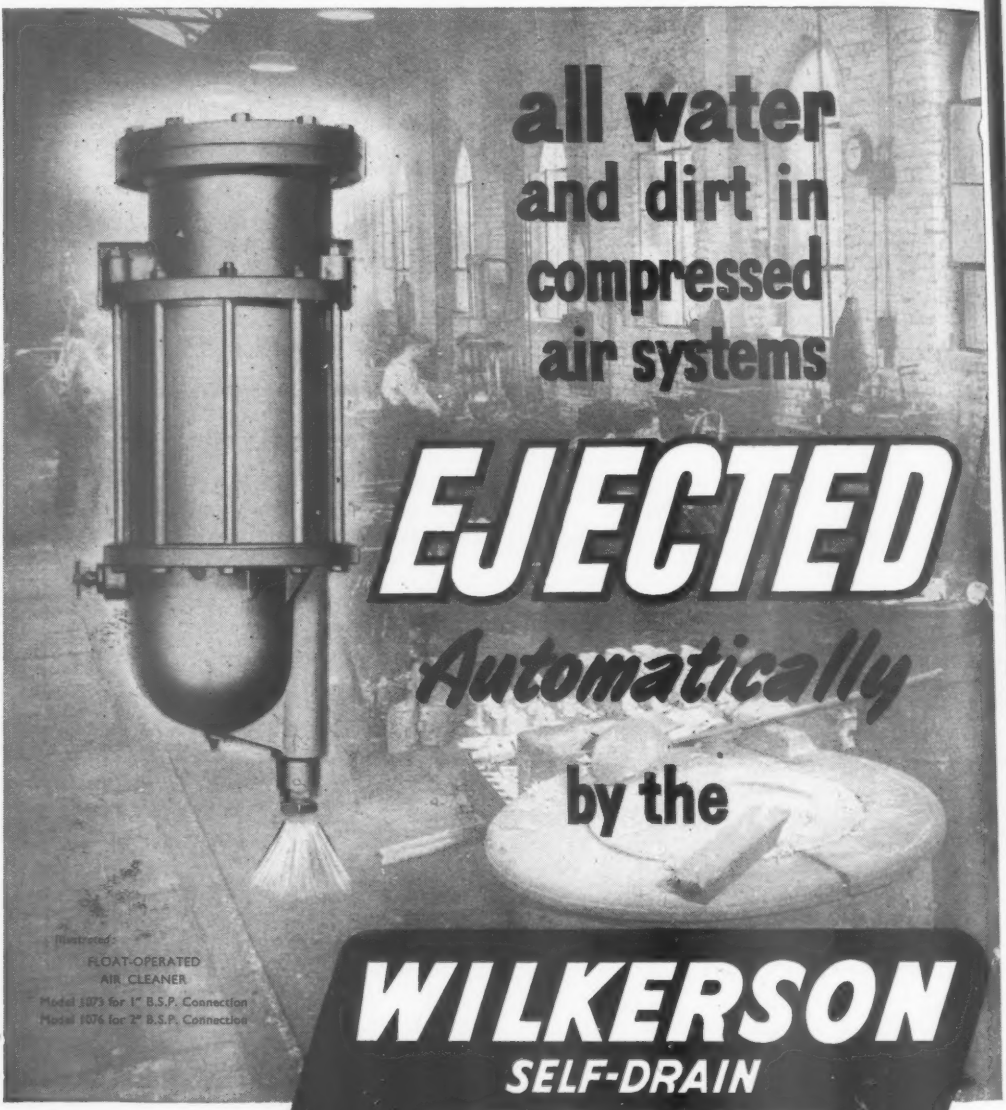

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These machines using the Modern 'Flexible' Abrasive Cutting Off Wheel give exceptional rates of production with extremely low wheel cost.

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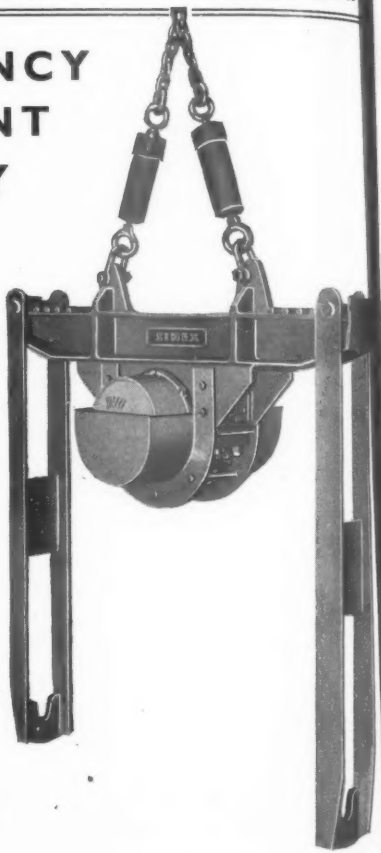
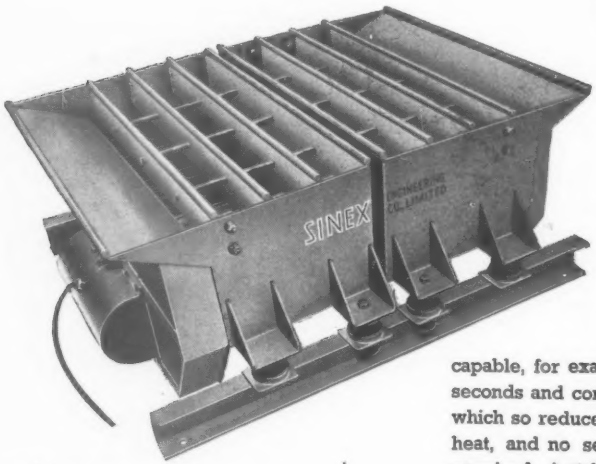


(Right)—The new Sinex Vibrating Beam has been specially developed for the transporting of Foundry Boxes to selected knock-out points. Any sized boxes can be handled and the most difficul sand castings can be dealt with in a few seconds. In view of the recent legislation introduced to obviate dust hazards in foundries, this equipment is essential in modern foundry practice, as knocking out can be carried out in any section of the foundry, which if necessary can be isolated, thus completely meeting with all requirements laid down by the new Act.



(Left)—The new Sinex high frequency Vibrating Knock-out Grids are constructed in two sections, each section being operated individually by a Sinex Vibrator. They are built in various sizes according to the boxes they are to deal with and are made to withstand the hardest wear. They are capable, for example, of de-sanding a 14-cwt. box in twenty seconds and completely eliminate manual handling of boxes, which so reduces their life. They are designed to withstand heat, and no separate power units, "V" belts, etc., are required, installation on site being an extremely simple matter. They can be supplied in special sizes to suit customers' own requirements if desired.

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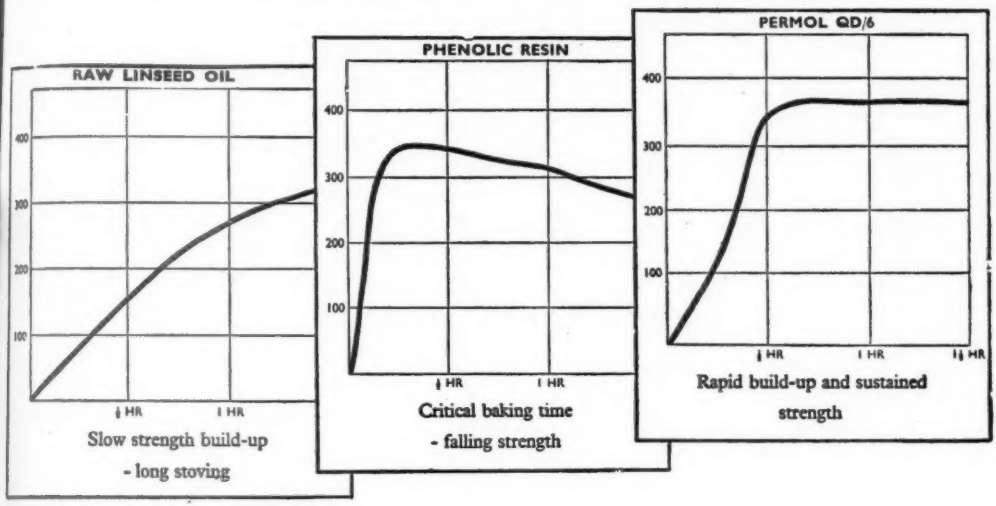
RAPID BAKING COREBINDERS



Slow strength build-up - long stoving

Critical baking time - falling strength

Rapid build-up and sustained strength

Which characteristics do you prefer?

During the last 25 years and more the GLYSO range of core bonding oils and compounds originated, developed and proved (as always, in the foundry) by FORDATH has earned fame throughout the industry; and the use of these products continues in huge volume.

In the ceaseless striving to speed up production, however, foundrymen identified shorter baking time, if it could be achieved, as the most likely way to increased production. A number of binders offering shorter stoving times became available—including Glyso Resyn Powder by Fordath. It has to be confessed, however, that the gain on the baking roundabouts was matched by losses on the swings of flowability, economy and bench-life.

What was obviously most desirable was a range of corebinders with all the admirable attributes of the GLYSO and PERMOL series—*plus* the rapid baking characteristic which gives such a fillip to production.

This is exactly what has been done in the FORDATH laboratories and proved in large scale core production in leading foundries over a period of 12 months. The result is the "QD" range of corebinders now offered with confidence to the foundry trade in general. These may be summarised as follows:

1. PERMOL QD/4 and QD/6. These have similar rapid-baking qualities, QD/6 having higher release properties and giving better strip and greater flowability for blowing.

2. GLYSO CREAM QD/10 and QD/12, both single addition binders, excellent for core blowing and light green bond work for castings of light or heavy section.

3. GLYSO QD/SS, a semi-solid core compound with rapid baking properties. Cores can be handled green without fear of sagging or distortion.

Every foundry requirement met handsomely by

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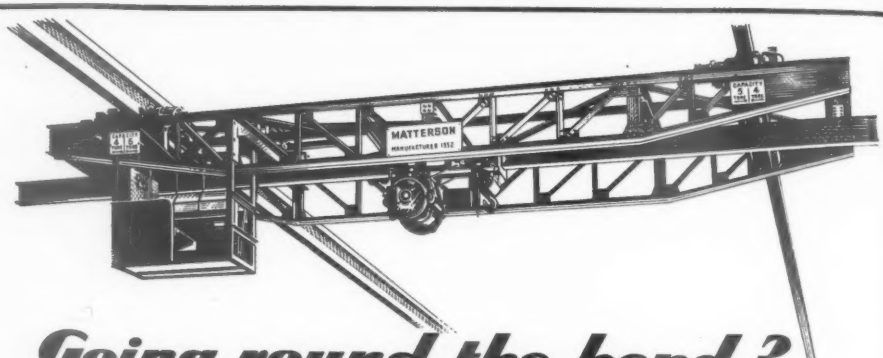

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1955 in Retrospect

Unquestionably, the outstanding event of 1955 was the International Foundry Congress organized by the Institute of British Foundrymen and held in London last June. Viewed from the social angle it was unquestionably a great success. As the majority of the papers were from overseas, it would be churlish to criticize and there was much to whet the appetites of all types of technicians. Many people were involved in making the arrangements, but outstanding were Dr. Everest and Mr. George Lambert.

Secondary features of 1955 in the foundry industry were the two conferences on foundry ventilation and dust elimination organized by the British Cast Iron Research Association and the British Steel Castings Research Association. Both focussed attention on problems which become more pressing with increased speed of production of castings. Another outstanding feature has been the very rapid development of the CO_2 Process, which has had its impact on jobs so widely different as moulds for heavy steel castings and cores for die-castings. The shell-moulding process, also, has made great progress, much of it resulting from the use of pre-coated sands, lower resin costs and appreciation of the real benefits to be derived from the reduced floor space required. The major impact of the process has been to make buyers of castings much more conscious of dimensional exactness than ever before.

Statistics sufficiently advanced to show that most sections of the industry have had a plethora of orders and by the time the year's figures are available some records will have been broken, and this in spite of the railway and other strikes. Another important event of the year was the holding of the foundry equipment exhibition. The four-yearly intervals between these certainly permit of many really new machines and processes to be shown. An impression left on our mind is the ever-narrowing gap between foundry plant and the machine tool. The appearance of much foundry plant is now of the highest quality and vies with the best to be encountered in engineering practice. We are satisfied that the majority of the foundry industry is making a serious effort "to put its house in order" and in one direction—that of accident reduction—it has been outstandingly successful over the last few years. As new processes become available they are actively exploited; if found economic they are developed, and, if uneconomic, discarded. As an industry, the foundry is broadminded, and the exchange of technical information is remarkably extensive and unquestionably beneficial. It is within our knowledge that this desirable attribute of the home foundry industry does add much to its prestige in overseas countries. If, as we are sure will be the case, the industry follows the precepts it has adopted since the last war, its future is not merely assured, but has every prospect of expanding.

IBF Meeting at Stoke

The first of a series of meetings arranged to promote interest in the Stoke area in the work of the Institute of British Foundrymen was held at the Town Hall, Hanley, on the evening of Thursday, December 15. The meeting, at which over 100 foundrymen were present, was presided over by Mr. Albert Kirkham, president of the Lancashire branch of the Institute. To emphasize the importance of the occasion, the national president, Dr. A. B. Everest, also attended and presented an excellent address outlining the work of the Institute. This was followed by a lecture by Mr. A. Talbot on the "CO_2 Process" which was very well received and provoked a most lively discussion.

The result of this meeting was so encouraging that a series of monthly lectures has been arranged at the same venue for early 1956, as follow:—January 19, "Castings for the Smithy and Forge," by W. Spenceley; February 16, "Some Aspects of a Jobbing Foundry," by A. Kirkham, and March 15, "Foundry Technique," by H. Haynes. It is hoped, if the support of these meetings is sustained, that it will be possible to form a North Staffordshire section of the Lancashire branch of the Institute.

Success in Exports

When it comes to the question of exports the voice of Mr. Leslie Gamage can usually be relied on for sound advice. He is president of the Institute of Export and at the Institute's annual meeting he stressed the need for every export department to be staffed with men trained in export techniques. No one would put an unqualified man in charge of an accounts or engineering department, yet in some companies anything was good enough for the export department, remarked Mr. Gamage.

While admitting that in the problem of delivery dates manufacturers were mostly to blame, Mr. Gamage suggested that better road and rail facilities to the docks and better port handling facilities would minimize delay in putting goods on board. He sympathized with exporters, whose minds were confused and irritated by the constant stream of advice from people who had never done an export transaction in their lives.

Since he entered the General Electric Company, Limited, in 1919, Mr. Gamage has specialized in export. He is vice-chairman and joint managing director of the company and serves on the boards of its overseas subsidiaries. Many times he has covered vast distances in undertaking on-the-spot business tours in the interest of GEC exports. His re-election to the presidency of the Institute of Export in May was for the thirteenth time in succession.

K & L Extension

During a visit to K & L Steelfounders & Engineers, Limited, to inspect a piece of new equipment (described on p. 777) a flying visit was paid to see the firm's recent extension. It is a section to manufacture the lighter types of castings, the patterns for which are capable of being mounted on machines. Special attention has been given to the provision of sand so compounded as to give a good surface on the castings. Installed is a magnificent new sand plant, operated by two men only; it appears to supply both core and moulding sands. The melting facilities include a 3½-ton Birlec Lectromelt arc and two 5-cwt. and one 10-cwt. high-frequency furnaces. Special attention is being paid to dust and fume removal.

Freeman of Stafford

The English Electric Company, Limited, has played no mean part in the growth and industrial development of Stafford, and it is fitting therefore, that Sir George Nelson, who has been chairman and managing director of the company for 22 years, should receive the freedom of the city. Since Sir George joined the English Electric Company as managing director in 1930, the concern has been built up into one of the largest industrial groups in Britain, and goods manufactured at its Stafford works are to be found in many parts of the world.

Before he was 18, Sir George, as a student of electrical engineering, had gained several outstanding awards. He was elected to the Institution of Electrical Engineers at the earliest age possible, and is its current president. His many other industrial activities have included the presidency of the Federation of British Industries, the vice-presidency of the Institution of Mechanical Engineers, and membership of the council of the British Electrical and Allied Manufacturers' Association. He is also chairman of D. Napier & Sons, Limited, the aero- and marine-engine manufacturers, Marconi's Wireless Telegraph Company, Limited, and the English Electric Export & Trading Company, Limited.

IBF Library

The Institute of British Foundrymen from its headquarters at St. John Street Chambers, Deansgate, Manchester, has issued a list of over 200 foundry technical books, handbooks, reports, encyclopaedias and directories held there in its library and available for borrowing by members. The rules for the conduct of this library service are: (1) Books are loaned to members in the United Kingdom for a maximum period of 14 days. (3) Members wishing to retain a book for a period longer than 14 days must apply to the secretary for an extension of the loan which will be granted if the book is not required by another member. (3) The Institute will pay the outgoing postage and the borrowing member the return postage. (4) Books are loaned on the understanding that members will bear the cost of replacing any books lost or damaged while in their possession.

Factory Equipment Exhibition

The Rt. Hon. Peter Thorneycroft, M.P., President of the Board of Trade, will open the 1956 Factory Equipment Exhibition which is being held at Earls Court from April 9 to 14. The exhibition, the fourth of its kind and the largest of the series so far, will occupy an area of 250,000 sq. ft.

Exhibits will cover factory construction, equipment and maintenance, the handling, storage and packing of goods, engineering products, equipment and services for the welfare and safety of operatives, drawing and works office equipment and supplies.

Dinner

"THE ENGINEER"

The Editor in Chief of *The Engineer*, Mr. B. Pendred, presided over a dinner held at the Savoy Hotel on December 20, to celebrate the 100th anniversary of this journal. The guests were the editors of technical papers which have been established over 25 years. The toast of *The Engineer* was given by Mr. F. B. Roberts, editor of *Engineering*.

Fluidity of Molten Cast Iron

By E. R. Evans, A.I.M., A.C.T. (Birm.)*

The ability of a molten metal to fill a mould completely and without such defects as "cold shuts" is an important property to the foundryman. In many iron foundries, and particularly those engaged in the production of light castings, misruns can be a serious problem and an understanding of the factors affecting the fluidity of the metal will be useful in overcoming this source of scrap. The fluidity of molten cast iron has been studied at the British Cast Iron Research Association,[1,2] and this article deals with the methods used and the main points emerging from the investigation. The significance of the results to the foundryman is also discussed.

Choice of Test Piece

The method usually adopted for measuring the relative fluidity of molten metal is to measure the distance the metal will flow along a narrow channel before freezing prevents further flow. It is most convenient to have the channel in the form of a spiral and most of the work on fluidity reported in the literature has been conducted using spiral-type test-pieces. After a careful study of methods of testing fluidity, a test-piece was chosen which would give reproducible results irrespective of normal variations of the moulding sand, moulding methods and pouring technique. This test-piece was a slightly modified version of the Saeger and Krynitsky spiral,[3] illustrated diagrammatically in Fig. 1, with a coresand pouring head designed to eliminate the effects of variations of pouring. At first, the pouring head was arranged so that three spirals were cast simultaneously and results checking one another could be obtained, but it was eventually found that a modified pouring head for a single spiral was satisfactory. Figs. 2 and 3 illustrate the two types of test-piece set up ready for pouring.

Factors Affecting Fluidity

The fluidity of cast iron is affected most by composition and pouring temperature, and series of experiments were planned to determine the relative effects of each. Irons of different compositions were melted in an oil-fired crucible furnace and fluidity test-pieces from each were cast at various measured temperatures. At the same time, a cooling curve was plotted for each material to determine the solidification temperature. The data from these experiments were plotted to illustrate the effect of pouring temperature on the fluidity of each iron and, from the graphs, the fluidity at any temperature could be interpolated for studying the effects of composition variations.

Phosphorus

The effect of phosphorus on the fluidity of an iron containing approximately 3 per cent. carbon and 2 per cent. silicon was determined first. Sulphur and manganese contents were kept as low as possible as the effects of these elements were to be determined later. It was found that fluidity was improved as the phosphorus content was increased but that, at the same time, the temperature of the commencement of solidification was correspondingly decreased. When fluidity at a given temperature above the solidification temperature was plotted, it was found that the increase of fluidity with phosphorus content was only slight.

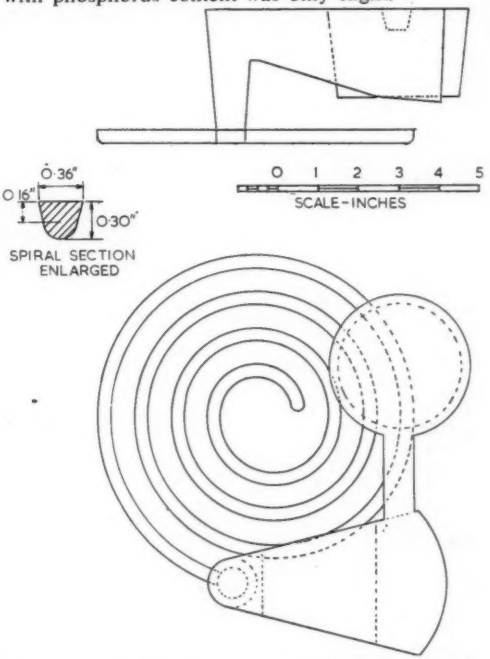


FIG. 1.—*Modified Saeger and Krynitsky fluidity test-spiral showing the relative positions of the pouring basin, down-gate, overflow channel, overflow basin and spiral channel; total length of spiral 60-in.*

The value of the use of phosphoric irons for obtaining fluid metal is thus more apparent than real. For a given melting temperature, irons of

* The Author is on the research staff of the British Cast Iron Research Association.

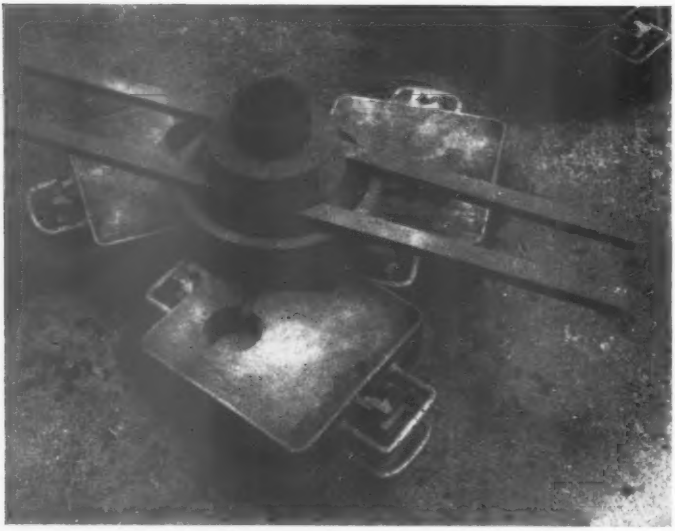


FIG. 2.—*Laboratory-type test-piece. Three fluidity spiral moulds can be cast simultaneously from a coresand pouring basin.*

high phosphorus have to cool through a larger range of temperature than do low-phosphorus irons before solidification commences, but in the cupola low-phosphorus irons melt at a higher temperature anyway. It has been shown that most castings can readily be run in low-phosphorus metal.

Carbon

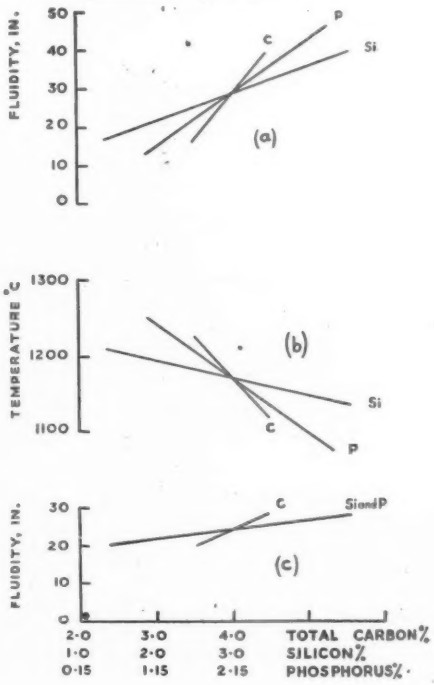
The effect of variations of carbon content on the fluidity of two base irons was determined. Both contained approximately 2 per cent. silicon but one contained about 0.04 and the other 1.2 per cent. phosphorus. As with the previous experiments on the effect of phosphorus, it was found that fluidity varied directly with increasing carbon and the solidification temperature varied inversely as the carbon increased. At a fixed increment of temperature above that of solidification commencement it was found that fluidity increased with carbon content to a greater extent than it did when phosphorous content was being considered.

Silicon

The variation of fluidity with silicon content on low- and high-phosphorus irons containing 3 per cent. carbon was also determined. Again, the results showed the same trend in that silicon improved fluidity but that when the corre-

FIG. 3.—*Mould for the modified test-piece developed by the Author.*

FIG. 4.—*Relative effects of carbon, silicon and phosphorus on (a) fluidity, (b) solidification temperature, (c) fluidity at 150 deg. C. above solidification temperature.*



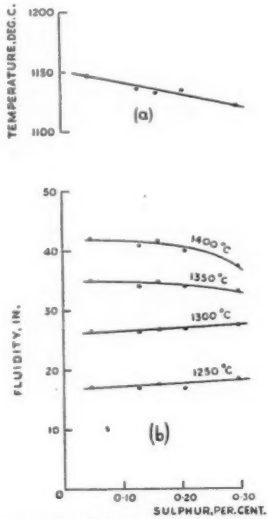
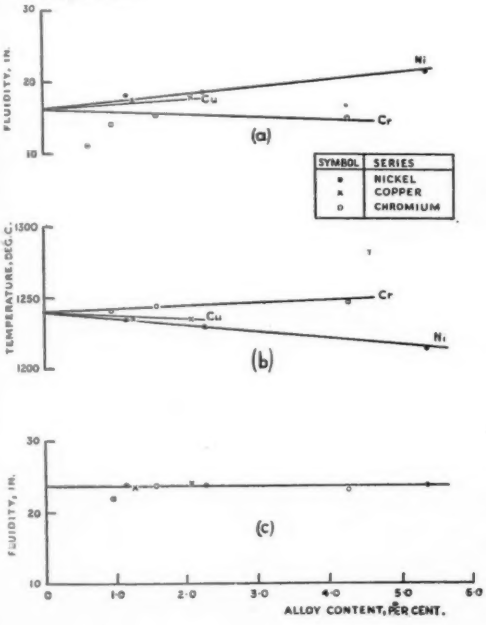


FIG. 5.—*Effect of sulphur content on (a) the solidification temperature, (b) the fluidity of an iron containing carbon* 3.15, *silicon* 2.20 *and phosphorus* 1.25 *per cent.*

sponding decrease of solidification temperature was taken into account the improvement of fluidity was

FIG. 6.—*Effects of nickel, copper, and chromium, on (a) fluidity, (b) solidification temperature, (c) fluidity at* 150 *deg. C. above solidification temperature.*



similar to that due to the increases of phosphorus content of the same order.

The effects of variations of carbon, silicon and phosphorus contents on the fluidity of an iron with basically carbon 3.0, silicon 2.0, and phosphorus 1.15 per cent., respectively, are illustrated graphically in Fig. 4. This diagram shows at (*a*) the effect on fluidity at 1,350 deg. C., at (*b*) the corresponding effect on the primary solidification temperature, and at (*c*) the corresponding effect on the fluidity at a temperature of 150 deg. C. above that of the commencement of solidification.

Manganese

The effect of manganese variations between 0.4 and 2.7 per cent. was found to be negligible on the fluidity of both low-phosphorus and phosphoric irons.

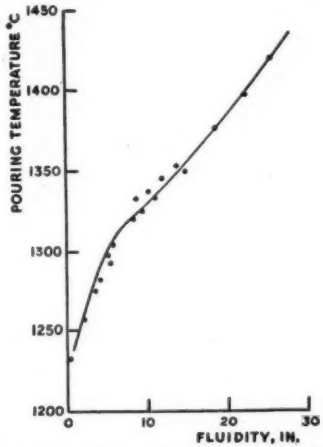


FIG. 7.—*Typical pouring-temperature/fluidity curve.*

Sulphur

Variations of sulphur content within the range 0.04 to 0.20 per cent. had no appreciable effect on the fluidity of cast iron. Above 0.2 per cent. sulphur, however, the fluidity tended to decrease, particularly at higher temperatures. Fig. 5 illustrates this point and shows the effect of sulphur on the fluidity of an iron containing carbon 3.15, silicon 2.2, and phosphorus 1.25 per cent. The fluidity up to 1,300 deg. C. is shown to be slightly improved by increasing the sulphur content, by virtue of the fact that the solidification temperature is correspondingly reduced, but above 1,300 deg. C. the fluidity is reduced markedly as the sulphur exceeds 0.20 per cent.

Other Elements

The effect on the fluidity of low- and high-phosphorus irons containing approximately carbon 3 and silicon 2 per cent., of small quantities of various other elements was determined. It was found that fluidity was affected only when the solidification temperature was correspondingly affected in most cases. Table I shows the elements and their ranges which were studied in this connection.

Fluidity of Molten Cast Iron

The effects of nickel, copper and chromium on fluidity and solidification temperature are illustrated in Fig. 6. Fluidity is slightly decreased by chromium and increased by nickel and copper, but this is entirely accounted for by the attendant changes of solidification temperature. Of the other elements studied, no change in fluidity was observed except for slight decreases in the cases of zirconium, aluminium and tellurium.

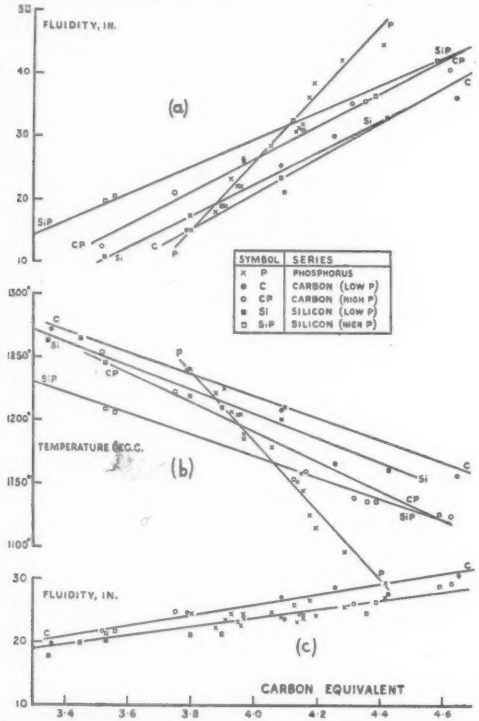


FIG. 8.—*Relationship between Carbon Equivalent and (a) fluidity, (b) solidification temperature, (c) fluidity at 150 deg. C. above solidification temperature.*

TABLE I.—*Additional Elements Considered.*

Element.	Maximum content studied (per cent.)
Nickel	5.3
Copper	2.1
Chromium	4.3
Molybdenum	0.94
Titanium	0.14
Vanadium	0.23
Zirconium	0.28
Aluminium	0.59
Tellurium	0.09
Boron	0.06

Cerium and Magnesium

Separate mention is made of these elements because of their special significance as alloying elements in cast iron. It was found that they had no effect on the fluidity of hypo-eutectic irons, but that the fluidity of hyper-eutectic irons was increased appreciably by their addition. The magnitude of the increase depended on the success of the addition in the production of nodular graphite structures and if the mechanical properties of the iron can be regarded as a measure of this success then fluidity can be related directly to it. Table II illustrates this point by showing the effect on an

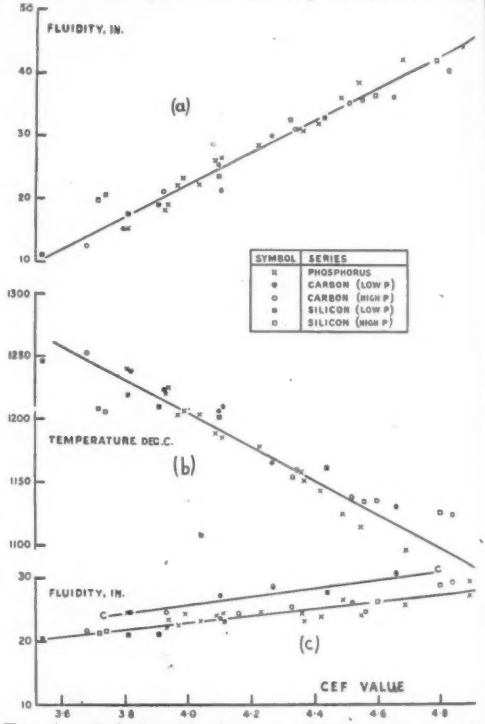


FIG. 9.—*Relationship between CEF value and (a) fluidity at 1,350 deg. C, (b) solidification temperature, (c) fluidity at 150 deg. C. above the solidification temperature.*

iron containing carbon 3.6, silicon 2.8 and phosphorus 0.05 per cent.

TABLE II.—*Fluidity and Tensile Strength of Ce- and Mg-treated Irons.*

Treatment.	Per cent. Ce	Per cent. Mg	Fluidity at 1,350 deg. C. (in.)	Ultimate tensile stress (tons per sq. in.)
None	—	—	35	6.2
With mischmetall	0.051	—	37	25.4
With mischmetall	0.075	—	39¼	27.3
With Ni/Mg alloy	—	0.094	43½	38.0
With Ni/Mg and mischmetall	0.007	0.054	49	42.2

Pouring Temperature

In all cases, irrespective of composition, increases in pouring temperature resulted in improved

fluidity. The relationship could not, however, be represented as a straight line, and all pouring

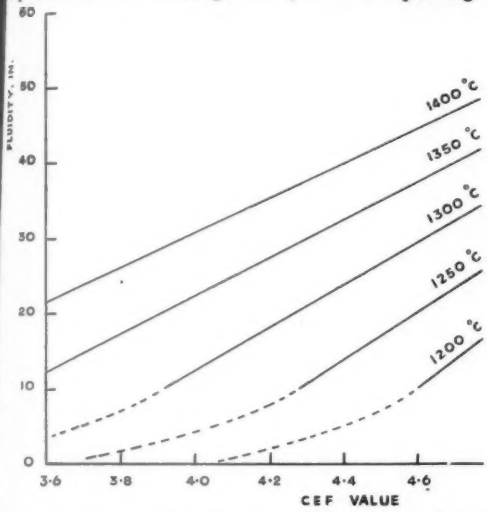


FIG. 10.—*Effect of pouring temperature and CEF value on the fluidity of molten cast irons.*

temperature/fluidity curves were of the form illustrated in Fig. 7. In the case of hypo-eutectic irons,

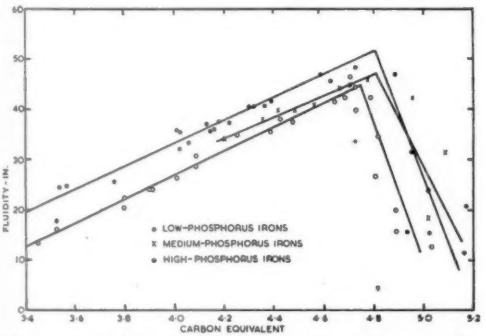


FIG. 11.—*Relationship between maximum fluidity and Carbon Equivalent.*

the point of zero fluidity corresponded with the temperature of the liquids, whereas in hypereutectic irons some degree of fluidity remained until the precipitation of the eutectic.

Relative Effects of Composition and Temperature

So far, it has been shown that the total-carbon content of cast iron is the most important composition factor affecting fluidity. It is, however, more convenient to discuss composition in terms of Carbon Equivalent, since this factor gives a much better guide to the type of properties that can be expected in the casting. A fully eutectic cast iron without silicon or phosphorus has a carbon content of 4.3 per cent. If those elements are present, the carbon required to make the iron fully eutectic changes, and the amount of change can be calculated. The generally accepted formula for calculating Carbon Equivalent is:

$$CE = T.C. + \frac{Si}{3} + \frac{P}{3}$$

—and for a eutectic iron, when Si and P are zero, the value is 4.3 per cent. All the fluidity results obtained in this investigation were plotted against the Carbon Equivalent of their compositions and the graph shown in Fig. 8 was produced. This illustrates that Carbon Equivalent and fluidity cannot be related directly and that phosphoric irons are more fluid than low-phosphorus irons of similar Carbon Equivalent. It also shows that this phenomenon occurs because high-phosphorus irons commence to solidify at a lower temperature than equivalent low-phosphorus irons. It is therefore not satisfactory to use the Carbon Equivalent to determine what effect certain changes of composition will have on fluidity at any temperature.

Another formula was derived by which composition could be related directly to fluidity. This was:

$$CEF = T.C. + \frac{Si}{3} + \frac{P}{2}$$

where CEF is the Carbon Equivalent based on fluidity.

This had the advantage that all irons of any definite CEF value had similar fluidity properties.

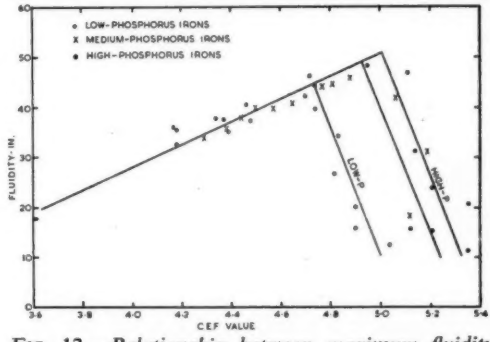


FIG. 12.—*Relationship between maximum fluidity and CEF value.*

The results mentioned earlier have been re-plotted in Fig. 9 to illustrate the variation of fluidity and solidification temperature with CEF value.

Besides composition, the other main factor influencing fluidity was pouring temperature, but because the temperature/fluidity relationship was not a simple one, allowance for it could not be made conveniently in the CEF formula. However, a study of the results showed that at temperatures which had practical significance in the foundry, a change of pouring temperature of 14 to 17 deg. C. had the same effect on fluidity as a change of 0.10 CEF value. The relative effects on temperature

and composition are illustrated graphically in Fig. 10.

Composition for Maximum Fluidity

In many alloys, it has been shown that maximum fluidity occurs at the eutectic composition. If it is accepted that the cast-iron eutectic has a Carbon Equivalent of 4.3, then it would be expected that eutectic cast irons were the most fluid. Tests have shown, however, that fluidity continues to improve as the Carbon Equivalent is increased beyond 4.3 and eventually reaches a maximum at about 4.75—beyond this value the fluidity falls rapidly. This is illustrated in Fig. 11 which also indicates that the maximum fluidity depends on phosphorus content.

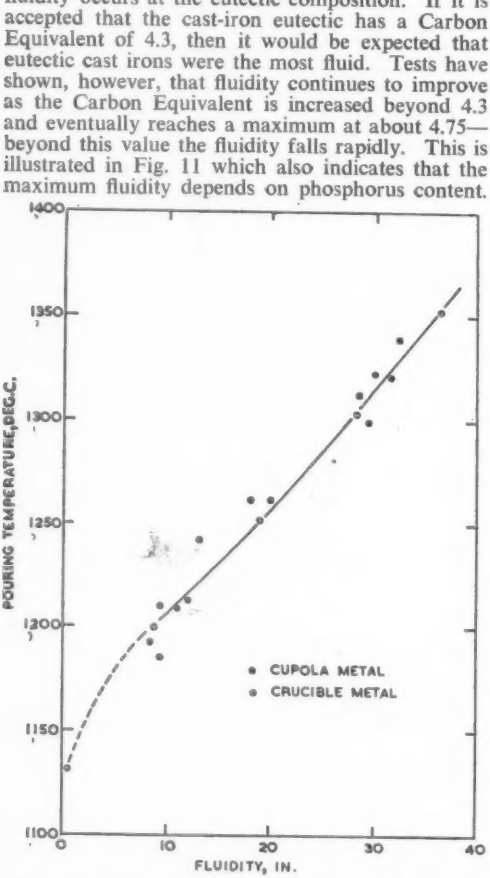


FIG. 13.—*Results of tests comparing cupola-melted and crucible-melted metal.*

When these results were replotted with the CEF value, it was shown that maximum fluidity still depended on phosphorus content and occurred at 4.75 CEF in low-phosphorus irons and 5.0 CEF in phosphoric irons, as illustrated in Fig. 12.

Field Tests

So far, only laboratory results on crucible-melted metal have been considered, but the co-operation of member-firms of the BCIRA made it possible for the results to be checked on cupola metal. It was found that in every case the fluidity of cupola-melted metal was similar to that of crucible-melted metal of the same composition and at the same temperature.

In cases where there were variations of composition, it was possible to correct the results by calculating the CEF values and applying a correction of ¼-in. fluidity for every 0.01 variation from the average CEF. In this manner, it was possible to compare directly the fluidity properties of cupola-melted metal with those of crucible-melted metal of exactly similar composition. The results obtained at one firm are shown in Fig. 13, in which the fluidity properties of cupola-melted and crucible-melted metal of similar CEF are compared.

"Oxidized" Metal

Some foundrymen have reported that sometimes metal from the cupola is "oxidized" and in this condition it has poorer fluidity than normal metal, although there is no apparent difference of composition and temperature. The production of so-called "oxidized" metal is due to abnormal conditions in the furnace and contributory causes are: low coke-bed, overblowing, bridging and the use of heavily-oxidized scrap in the charges.

Attempts to produce "oxidized" metal by blowing air or oxygen through crucible-melted metal did not yield the required condition and the treated iron possessed the same fluidity as the untreated iron at the same temperatures. Again the co-operation of member-firms was sought and tests were carried out at two foundries. In both cases "oxidized" metal was produced by deliberately creating the abnormal conditions mentioned above.

At one foundry an iron was produced which had slightly less fluidity than the normal product, but temperature measurement showed that this was entirely due to lower temperatures. The results are plotted in Fig. 14 which illustrates that the pouring temperature/fluidity relationship was normal and that the "oxidized" metal was merely cold metal.

At the other foundry "oxidized" metal was produced in a similar manner and again the metal had inferior fluidity compared with that of normal metal. In this case, however, the poorer fluidity was entirely due to composition changes, notably lower carbon and silicon contents. When these changes were taken into account, the fluidity characteristics of "oxidized" metal were found to be perfectly normal.

Fig. 15 illustrates the results obtained after corrections had been made for differences of CEF value. In all cases, the "oxidized" metal had lower CEF values than those of normal cupola metal produced from similar types of charge.

Significance of the Results

There are several points in the results which are of practical significance to the foundryman. First, there is nothing mysterious about fluidity characteristics. The fluidity of molten cast iron depends entirely on temperature and composition and will vary only if these factors vary.

Secondly, and this is probably the most important point, temperature has by far the greater influence

on fluidity. It has been shown that a change of 14 to 17 deg. C. will affect fluidity as much as a CEF variation of 0.1. The differences in temperature between the first and last ladles of metal from a single bogie can therefore account for a bigger change of fluidity than compositional variation throughout a day's melt. This tends to show that most "misruns" are due to cold metal.

Thirdly, so-called "oxidized" metal has the same fluidity as normal metal of the same base composition at the same temperature. The apparent anomalies in connection with "oxidized" metal may have something to do with the appearance of the metal surface giving the impression that the metal is hotter than it actually is.

Fourthly, high-phosphorus content is not an essential to good fluidity. Lower-phosphorus irons can be equally as fluid at the same temperatures if there is a correspondingly higher carbon or silicon content.

Fifthly, the most-fluid irons are those which have a Carbon Equivalent slightly in excess of that normally accepted as eutectic composition. In many foundries making light iron castings, this point has been appreciated and irons with Carbon Equivalents of 4.5 and 4.6 are often employed.

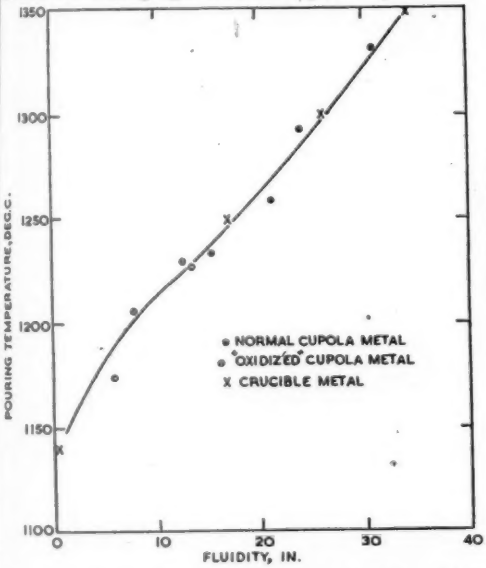


FIG. 14.—*Poorer fluidity of "oxidized" metal attributed to low temperature.*

Misrun castings are caused primarily by the metal being insufficiently fluid for the job, but there are contributory causes in the method of pouring and the design of the casting and its runner system. If occasional castings misrun then the probable reason is that they have been poured too slowly. If "misruns" are a particular hazard with one particular casting then the design of the runner system should be investigated. If a foundry experiences alternate trouble-free periods and periods of "misruns," then the probable trouble is temperature variation, and if the trouble persists it is almost certainly due to cold metal. In many foundries the metal has to be transported some considerable distance from the furnace to the mould. In such cases, the use of covered- or drum-type ladles is to be recommended to minimize heat losses.

Fluidity Test for Control Purposes

The fluidity test is a useful tool for investigating change of fluidity attendant upon any other variable. Once the relationship has been established, however, the test loses much of its value and its use is not to be recommended for routine purposes. If cupola practice is sufficiently well controlled to ensure that iron of the correct composition is being produced, then the measurement of temperature is easier and more informative than the measurement of fluidity. Each casting may be regarded as its own fluidity test, and when trouble occurs it may be assumed that hotter metal is required.

The Author is indebted to the Council and director of the British Cast Iron Research Association for permission to publish this account.

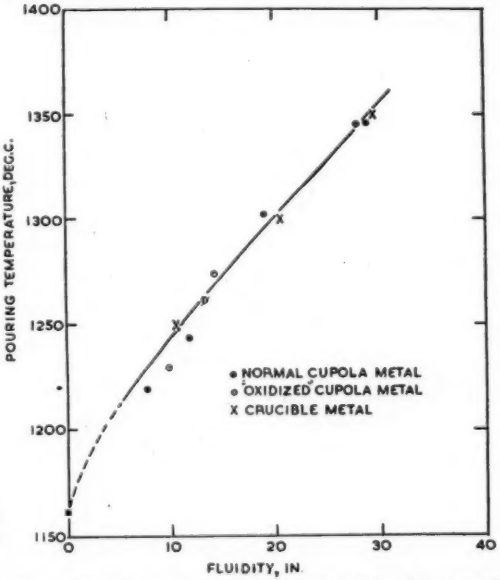


FIG. 15.—*Poorer fluidity of "oxidized" metal attributed to compositional changes. The fluidity values for "oxidized" metal have been corrected for direct comparison with normal cupola metal.*

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F

Solving a National Dilemma

Many industrial nations are now faced with a crisis in the use of their manpower. This crisis is not always in the use of the numbers available for work, as in Britain now, but rather in solving the deepening dilemma of morale—a morale which makes men face up to their work "responsibilities" as responsively as they do to the achievement of their "rights." In an article entitled "Morale, a National Dilemma," Mr. John Marsh, director of the Industrial Welfare Society, says in the society's journal that when there are more jobs than there are people to fill them, a certain proportion of the population—say 10 per cent. or so—indulges in "an extraordinary mobility which is often wasteful to the nation, is retarding and costly to employers, and to more stable employees must be, to say the least, unsettling. It reveals itself in economic pressures, unofficial strikes, and the countless instances of personal indiscipline, which seem to be much to the fore in some industries."

Many reasons are given for the malaise, Mr. Marsh continues, but in his opinion it is all part of man's discovery that he is increasingly a victim of large-scale society, its organization, and its movements. The answer, he feels, is to think in the new social dimensions of our time, and to accept them as challenges, with the same perseverance with which we address ourselves to scientific and technological development.

Mr. Marsh points out that many firms are rarely faced with the problem of low morale and irresponsibility. They have a well-thought out industrial relations policy, a consistent record of justice to customers, shareholders, and employees alike, a general atmosphere of humane efficiency starting from the top, and, not least, they reap the fruits of careful selection and training of leaders at all levels.

"It is significant, however, that much of the national dilemma is revealed in trades where men are scattered and work in isolated groups. Mining, transport, docks, and the building industry would seem to have twice the problem. All the money and experimenting which these great industries care to spend on developing leaders will therefore surely be worth while.

Raw Material Price Increases

Mr. C. Bradshaw, chairman of J. H. Fenner & Company (Holdings), Limited, power transmission engineers, Hull, Cleckheaton, Heckmondwike, and other centres, has called attention to difficulties of the supplies of adequate raw materials and the way in which rising prices threaten exports. He and Mr. S. B. Hainsworth, in a join statement, say that in some cases, notably steel, there is a shortage, but the continued upward trend in prices is the major problem. These rise so fast that it is impossible to pass on the increase to customers. However, when it comes to export, the company was competing with countries whose standard of living was not comparable with that of the UK. "If we were to think only of the making of profits, we should reduce our overseas business by 25 to 50 per cent. and allow the goods, which are at present being sent to certain markets, to be sold at home with little risk of non-payment and better profit margins in some cases." Nevertheless, the statement adds, the time would come when the overseas markets would be needed therefore they must be kept open. It was also of benefit to have to compete in price, quality and performance with other countries. Moreover, complete specialization on the needs of the home market would be the way to extinction for the company, and perhaps also for the nation.

Hadfields & Millspaugh

In reply to three directors of Millspaugh, Limited, board and paper making machinery makers, of Sheffield—Mr. S. Howard, Mr. K. F. Landegger, and Mr. M. F. Reid—who oppose the bid of Hadfields, Limited, for the company, the other four Millspaugh directors reaffirm their view that the offer should be accepted. These four members of the board are Mr. R. C. Hey, managing director, Mr. H. V. Dearden, assistant managing director, Mr. C. Harnden, and Mr. H. E. Jackson.

The four directors' answer to the call for a dividend of 20 per cent. for 1954-55 is that, while the estimated profit would cover it, it would be highly imprudent to pay 20 per cent., bearing in mind that overdraft amount to over £550,000; the increasing amount of work to be financed; that essential capital outlay must be financed out of retained profits; and that 20 per cent. could only be paid by further increasing the overdraft.

They add that the profit figures for the two periods 1946-50 and 1951-55 are not comparable—the 1946-50 profits being for a group of three companies and those in 1951-55 for eight. They say that Millspaugh's "growth potential" can be more readily achieved by having behind it all the resources of Hadfields.

Their three opponents in a further letter reiterate their viewpoint, adding that any holder wishing to dispose of his shares would be well advised to consider selling his stock on the Stock Exchange rather than accept the offer.

From the other "camp," Mr. J. B. Thomas, a former chairman of Millspaugh, and Sir Arthur Matthews, formerly deputy chairman, have no hesitation in advising acceptance of the offer.

Amendments to Clean Air Bill

No fewer than 70 amendments to the Government's Clean Air Bill, the committee stage of which is expected to start after the Christmas recess, have been tabled by Mr. Gerald Nabarro, the Conservative Member for Kidderminster. Mr. Nabarro it was, of course, whose own private bill on the same subject was withdrawn after a promise from the Government to bring in a bill of its own. Most of Mr. Nabarro's amendments are supported by the National Smoke Abatement Society, representatives of local authorities and by several members of the Beaver Committee which was responsible for the report on which the Bill was based.

Mr. Nabarro proposes to increase the fine proposed in the Bill for the emission of dark smoke by a private house from £10 to £100, on second offence. The fine for emission of dark smoke by an industrial chimney would be increased from £100 to £1,000. He would like local authorities, such as Liverpool and Manchester, who could satisfy the Minister that they have the technical resources to take over from the Alkali Inspectorate responsibility for controlling noxious fumes as well as dark smoke, and he proposes that the Bill should apply to smoke from engines in works sidings, as well as to engines in railway service.

Other amendments provide that industrial boilermen should have certificates of proficiency. Mr. Nabarro thinks it unsatisfactory that last year only 650 boilermen out of 75,000 underwent courses.

INDUSTRIAL PRODUCTS (REFRACTORIES), LIMITED, announce their change of address to 9, Northumberland Road, Sheffield, 10 (telephone, Sheffield 64364).

Gases in Cast Iron

Account of the British Contribution to the Study of this Problem submitted on behalf of the Joint Committee of the Institute of British Foundrymen and the British Cast Iron Research Association . . . . By the chairman, H. Morrogh*

(Continued from page 735)

Influence of the Individual Gaseous Elements

Simultaneously with the study of the gas content of commercial melts, work has been carried out in the laboratories of the B.C.I.R.A. on the influence of the individual gaseous elements by the synthetic approach. Melts were made and the oxygen and nitrogen contents were deliberately varied. This work is not yet completed but in what follows an account is given of the principal findings to date.

Oxygen

Williams[4] studied the effect of varying oxygen content on chilling tendency. He added various oxides to the molten metal shortly before casting and managed to obtain oxygen contents ranging from 0.0010 to 0.0070 per cent. (10 to 70 p.p.m.). He cast chilled blocks and carefully measured the pouring temperatures, which were 1,320 or 1,340 deg. C. in each case. Details of a typical series of experiments by this investigator are given in Tables VII and VIII.

Fig. 8 shows the appearance of the fractures of this series of chilled blocks—the depth of chill does not appear to vary with oxygen content and it was concluded that variations in oxygen content itself do not influence the chilling tendency of an iron.

Smith[5] similarly studied the influence of varying oxygen content on the annealability of malleable iron. By additions of Fe_3O_4 to the melt shortly before casting he was able to produce white irons for malleablizing having between 0.0015 per cent. (15 p.p.m.) oxygen and 0.011 per cent. (110 p.p.m.) oxygen, but he was unable to detect any change in rate of graphitization or in the microstructure of the resultant malleable iron. This investigator also made additions of Fe_3O_4 to molten metal initially treated with a small amount of aluminium. Table IX gives treatment and analytical details of such a series.

In this case, Smith found increasing oxygen content to have a marked influence on rate of graphi-

TABLE VII.—*Details of Treatment in Williams' Experiments.*

Chill Test No.	Treatment.
1	30 lb. Metal poured into a pre-heated, fireclay-lined ladle and allowed to cool to 1,320 deg. C. when the chill test-piece was cast.
2	30 lb. Metal poured on to 50 gm. Fe_3O_4 powder (≡ 0.1 per cent. O). A fluid slag formed rapidly after the initial sparking. This was plunged into the metal before casting at 1,320 deg. C.
3	50 lb. Metal poured into the ladle and allowed to cool to 1,340 deg. C. 100 gm. Fe_3O_4 powder (≡ 0.125 per cent O) was then added to the surface of the metal and plunged. There was a considerable boil during plunging and a fluid slag formed rapidly. The metal was cast immediately after plunging.
4	50 lb. Metal poured on to 100 gm. Fe_3O_4 powder (≡ 0.125 per cent. O), allowed to cool and then plunged. The metal was cast at 1,320 deg. C.
5	50 lb. Metal poured into the ladle, allowed to cool to 1,340 deg. C. and 200 gm. Fe_3O_4 powder (≡ 0.25 per cent. O) added to the surface of the metal. This was plunged into the metal and the chill test-piece cast immediately.
6	50 lb. Metal poured into the ladle and allowed to cool to 1,340 deg. C.; 100 gm. Fe_2O_3 (red oxide) added, plunged, and cast immediately. (This powder was claimed to contain some iron-carbonate which caused the metal to boil violently when plunged.)

* Presented at the International Foundry Congress in London, last June.

TABLE VIII.—*Composition of Chill Test-pieces from Williams' Experiments.*

Chill Test No.	Composition, per cent.					Oxygen, p.p.m.	Hydrogen, p.p.m.	Nitrogen, p.p.m.
	T.C	Si	Mn	S	P			
1	3.48	0.61	0.52	0.051	>0.1	10	0.8	40
2	3.50	0.56	0.46			35	1.0	40
3	3.49	0.57	0.48			40	0.9	40
4	3.50	0.59	0.48			30	1.1	45
5	3.48	0.56	0.45			70	1.0	50
6	3.50	0.59	0.48			20	1.0	50

TABLE IX.—*Influence of Treatment on the Gas Content of Malleable Cast (Smith) Iron.*

No.	Oxygen, p.p.m.	Hydrogen, p.p.m.	Nitrogen, p.p.m.	Composition, per cent.					
				T.C	Si	Mn	S	P	Al
2A Untreated; poured at 1,360 deg. C.	10	1.0	45	3.09	0.56	0.34	0.104	0.067	n.d.
2B 0.01 per cent. Al added; poured at 1,380 deg. C.	15	1.0	45	3.05	0.53	0.34	0.107	0.058	Present
2C 25 gm. Fe_3O_4 added at 1,400 deg. C.	30	1.1	50	3.02	0.55	0.34	0.107	0.058	,,
2D 50 gm. Fe_3O_4 added at 1,400 deg. C.	38	1.2	51	3.00	0.52	0.33	0.109	0.060	,,
2E 100 gm. Fe_3O_4 added at 1,400 deg. C.	70	1.5	53	3.06	0.52	0.33	0.108	0.060	,,

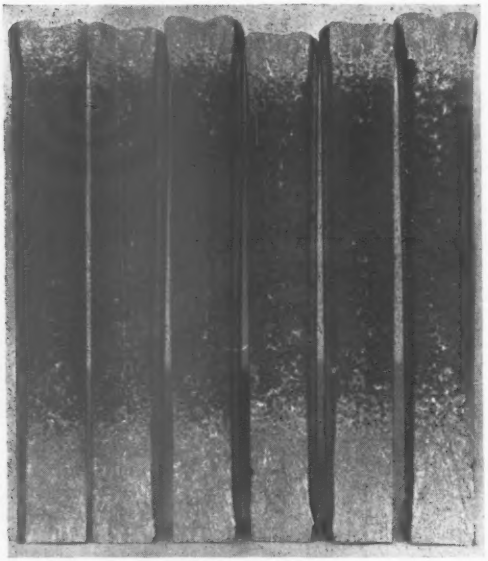


FIG. 8.—*Fractures of chilled blocks cast from metal of various oxygen contents. Left to right*—10, 35, 40, 30, 70 and 20 *p.p.m. oxygen* (*after Williams*[6]).

tization and microstructure of the malleable iron produced. Fig. 9 shows a comparison of graphitization rates for this series as indicated by a dilatation test. This test records the expansion, due to graphitization. It can be seen that the rate of expansion, and hence rate of graphitization, of sample 2E is much slower than that of 2B. The times to complete first-stage graphitization are indicated in Table X.

Fig. 10 illustrates the structure of sample 2B, showing numerous nodules in a matrix of ferrite. Fig. 11 shows the structure of sample 2E which has relatively coarse nodules. Clearly an increase in oxygen content in an iron having a trace of aluminium can result in a carbide-stabilizing effect. Thus it would appear that the reported carbide-stabilizing effect of oxygen is due to the removal or neutralization of an element, such as aluminium, having a graphitizing influence.

Bach[7] has made a survey of the theoretical aspects of oxygen in cast iron. He has drawn attention to the inadequacy of the available data, but he has indicated that the oxygen content found in cast irons is of the same order as that predicted by theory. This implies that the oxygen in liquid cast iron is largely in solution. Foundrymen often ask about the form of oxygen in liquid cast iron and imagine that it must be present as iron oxide or silica, or carbon monoxide. Oxygen in solution is unlikely to be in any of these forms, but of course the oxygen atoms are likely to be associated to some extent with iron, silicon, manganese and carbon. This discussion does not rule out the possibility that some melts do contain suspended particles of oxides and silicates, but these have yet to be identified.

TABLE X.—*Influence of Oxygen Content on the Rate of Graphitization of Malleable Iron* (*Smith*).

No.	Time to complete first-stage graphitization at 950 deg. C.	Oxygen, p.p.m.	Aluminium.
2A	17¼ hours	10	n.d.
2B	8¼ hours	15	Present
2C	9¾ hours	30	,,
2D	8¼ hours	38	,,
2E	17¼ hours	70	,,

TABLE XI.—*Influence of Nitrogen on the Tensile Strength of Hypo-eutectic Irons.*

No.	Composition, per cent.					Nitrogen, p.p.m.	Tensile strength, tons per sq. in.
	T.C.	Si	Mn	S	P		
1	3.43	1.61	0.62	0.085	0.054	60	14.1
2	3.53	1.55	0.62	0.078	0.066	201	18.1
3	3.52	1.56	0.62	0.075	0.069	235	mottled

Nitrogen

Dawson, Smith and Bach[1 8 9] have carried out an extensive investigation on the influence of nitrogen in cast iron at the B.C.I.R.A. laboratories. The results obtained indicated nitrogen to have power-

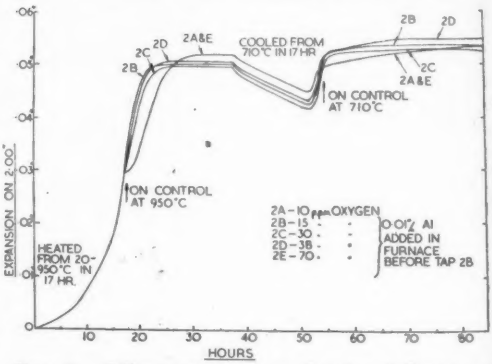


FIG. 9.—*Dilatometer curves showing influence of neutralization of aluminium by oxygen on the rate of graphitization of malleable iron* (*after Smith*[5]).

ful metallurgical effects. These investigators found that the nitrogen contents of cast-iron melts could be varied by treatment with nitrogeneous compounds such as sodium ferro-cyanide, calcium cyanamide and ammonium chloride. They quickly found that nitrogen could exert a powerful carbide-stabilizing effect. The analyses given in Table XI refer to melts of a hypo-eutectic iron treated in the manner described and cast in the form of standard 1.2-in. dia. bars. Fig. 12 shows the structure of bar No. 1 with 0.0060 per cent. (60 p.p.m.) nitrogen, Fig. 13 shows that of bar No. 2 with 0.020 per cent. (200 p.p.m.) nitrogen, and Fig. 14 shows bar No. 3 with 0.0235 per cent. (235 p.p.m.) nitrogen. Bar

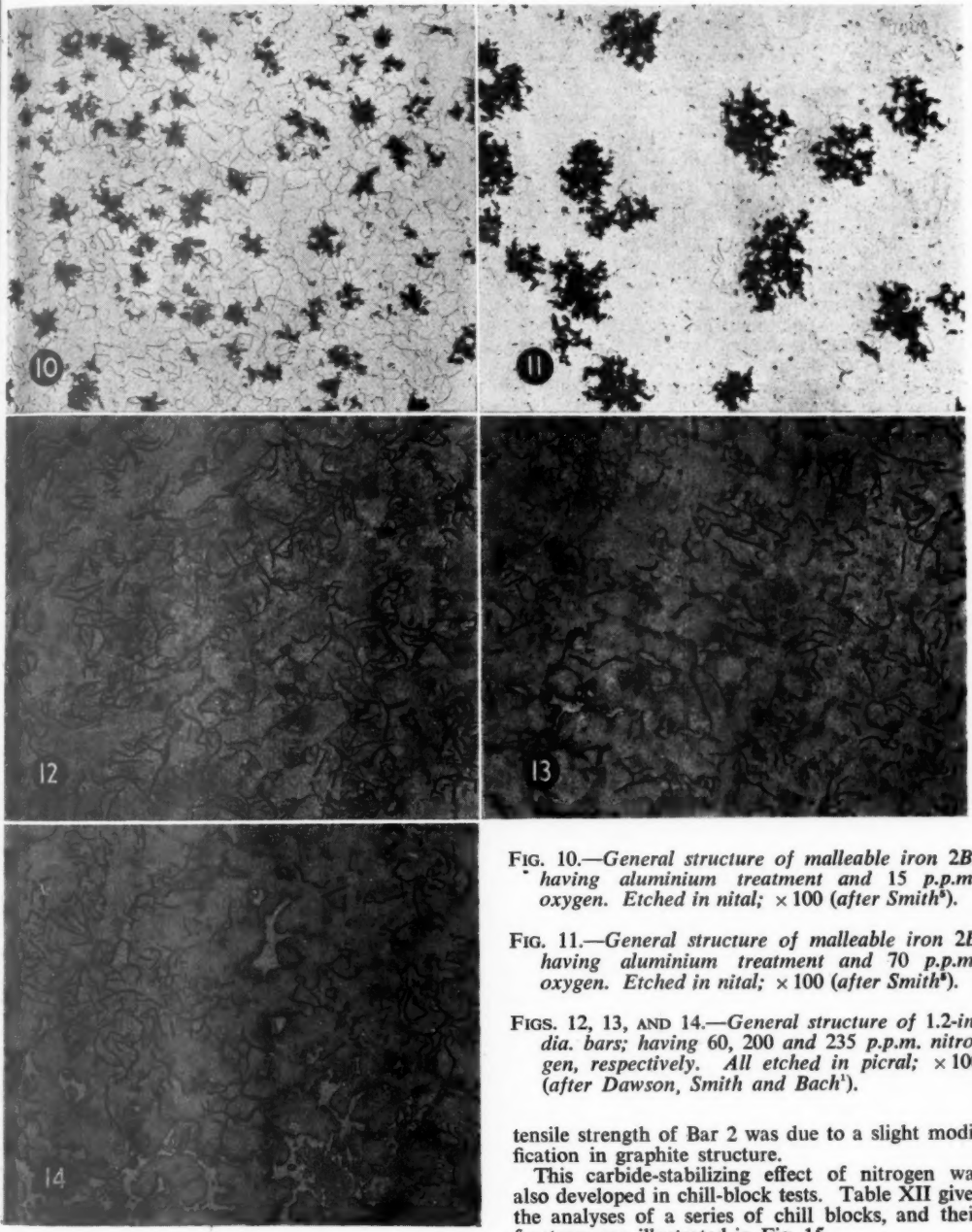


FIG. 10.—*General structure of malleable iron* 2B, *having aluminium treatment and* 15 *p.p.m. oxygen. Etched in nital;* ×100 (*after Smith*[5]).

FIG. 11.—*General structure of malleable iron* 2E *having aluminium treatment and* 70 *p.p.m. oxygen. Etched in nital;* ×100 (*after Smith*[5]).

FIGS. 12, 13, AND 14.—*General structure of* 1.2-*in. dia. bars; having* 60, 200 *and* 235 *p.p.m. nitrogen, respectively. All etched in picral;* ×100 (*after Dawson, Smith and Bach*[1]).

No. 3 had considerable amounts of eutectic carbide and its fracture had a mottled appearance. The carbide-stabilizing effect of the nitrogen increase is clearly shown by this series. The improvement in tensile strength of Bar 2 was due to a slight modification in graphite structure.

This carbide-stabilizing effect of nitrogen was also developed in chill-block tests. Table XII gives the analyses of a series of chill blocks, and their fractures are illustrated in Fig. 15.

With very high nitrogen contents considerable unsoundness, "bleeding" and swelling of the test-pieces was experienced. The latter feature is revealed in the last chill block in the series shown in

Gases in Cast Iron

TABLE XII.—*Composition of Chill Blocks containing Nitrogen (see also Fig. 15).*

Melt No.	Composition, per cent.					Nitrogen, p.p.m.
	T.C.	Si	Mn	S	P	
4a	3.53	0.60	0.52	0.042	0.052	70
4b	3.56	0.62	0.52	0.056	0.050	70
4c	3.69	0.62	0.52	0.055	0.052	90
4d	3.64	0.60	0.53	0.053	0.058	150
4e	3.63	0.61	0.52	0.047	0.058	240
4f	3.60	0.58	0.51	0.048	0.063	335

Fig. 15. Fig. 16 illustrates the influence of nitrogen content on the "bleeding" and "mushrooming" of the heads of standard 0.875 in. dia. bars. It was also found that the very high nitrogen-contents deliberately produced were considerably reduced to nearly normal values on remelting.

The carbide-stabilizing effect of nitrogen could also be detected on the matrix structure of grey irons. This is illustrated in Figs. 17 and 18 showing the structures of 1.2 in. dia. bars having 0.0050 per cent. (50 p.p.m.) and 0.0175 per cent. (175 p.p.m.) nitrogen respectively—the former being partially ferritic and the latter completely pearlitic. The analyses and mechanical properties of these two bars are given in Table XIII.

The carbide-stabilizing influence of nitrogen was also established for malleable iron. Samples of white iron were annealed for 48 hours at 950 deg. C.; the analyses of these are given in Table XIV. Iron No. 1 was completely graphitized after this heat-treatment, as shown in Fig. 19. Iron No. 2 had a small amount of carbide but iron No. 3 had a large amount of residual carbide, as illustrated in Fig. 20. This carbide-stabilizing effect was demonstrated for material subjected to an industrial malleablizing cycle.[8] Fig. 21 illustrates the influence of nitrogen on the time required for the completion of first- and second-stage graphitization based on data obtained from dilatometer studies.

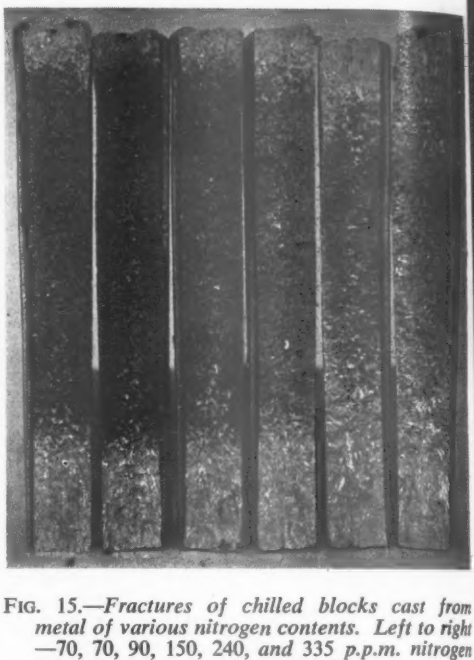


FIG. 15.—*Fractures of chilled blocks cast from metal of various nitrogen contents. Left to right* —70, 70, 90, 150, 240, *and* 335 *p.p.m. nitrogen (after Dawson, Smith and Bach*[1]).

TABLE XIII.—*Composition and Properties of Two Nitrogen-containing Grey Irons.*

No.	Composition, per cent.					Nitrogen, p.p.m.	Tensile strength, tons per sq. in.	Brinell hardness number.
	T.C	Si	Mn	S	P			
1	3.29	3.46	0.58	0.077	0.067	50	6.2	138
2	3.35	3.62	0.58	0.072	0.068	175	9	185

TABLE XIV.—*Composition of White-iron Samples containing Nitrogen.*

No.	Composition, per cent.						Nitrogen, p.p.m.
	T.C	Si	Mn	S	P	Al	
1	3.05	0.55	0.37	0.101	0.057	<0.01	70
2	3.07	0.56	0.36	0.100	0.060	<0.01	240
3	3.11	0.54	0.37	0.080	0.070	<0.01	470

TABLE XV.—*Irons Used in Tests Designed to Show the Influence of Aluminium Additions to Nitrogen-containing Malleable Irons.*

No.	Composition, per cent.						Nitrogen, p.p.m.
	T.C	Si	Mn	S	P	Al added, per cent.	
1	3.14	0.52	0.32	0.107	0.059	Nil	70
2	3.14	0.52	0.32	0.099	0.058	0.01	70
3	2.98	0.53	0.37	0.109	0.056	0.01	185
4	3.17	0.52	0.32	0.103	0.059	Nil	185

N.D. = not detected.

It was found that the carbide-stabilizing influence of nitrogen could be readily neutralized by means of aluminium additions. Fig. 22 gives dilatometer curves for malleable iron melts at two nitrogen levels with and without aluminium additions. The analyses of these irons are given in Table XV.

Clearly the aluminium additions greatly increased the rates of first- and second-stage graphitization. That aluminium should neutralize the effects of nitrogen is not particularly surprising since it forms an aluminium nitride and in irons of high nitrogen content containing aluminium it was possible to find aluminium nitride in the structure.

Dawson, Smith and Bach also produced evidence to show that silicon tended to reduce the solubility of nitrogen in cast iron but the effect was only noticeable with very high silicon contents.

FIG. 16.—*Showing the influence of nitrogen on bleeding of test-bar feeder heads. Left to right*—470, 240 *and* 70 *p.p.m.* (*after Dawson, Smith and Bach*[1]).

Summarizing about nitrogen in cast iron, it can be said that this element can have a powerful carbide-stabilizing effect and, in large amounts, could also give rise to unsoundness, but both of these effects can easily be neutralized by small additions of aluminium. The graphitizing effects of aluminium additions are often attributed to the combination of this element with oxygen. It now appears that this well-established explanation is unlikely. In considering these results on the effects of nitrogen it should be noted that the carbide-stabilizing effects and unsoundness were only detected when amounts of nitrogen, usually considerably greater than those met with in practice, were added. Nevertheless, variations of 0.0015 to 0.014 per cent. (15 to 140 p.p.m.) nitrogen were reported by Bach[3] in various industrial melts. (Very high nitrogen (0.18 per cent.; 1,800 p.p.m.) and high hydrogen contents (0.0006 per cent.; 6 p.p.m.) were found in electric-furnace-melted high-chromium irons but these results are perhaps not of general significance.) Such variations in nitrogen content from plant to plant would be expected to lead to differences, but these would be difficult to detect. In any case, small variations of nitrogen are unlikely to have an effect in the presence of small amounts of aluminium and small amounts of titanium, both of which occur by design or accident in many British irons. Furthermore, the effect of nitrogen in practice is likely to be subtle. It might in some cases be responsible for the variations in annealability of irons produced at different plants and it may be of significance to the chilled-castings industry. In general, field tests[3] have indicated a much greater variation in nitrogen content between different plants than ever occurs at a given plant. In this connection results made available to the Joint Committee by Dr. R. V. Riley on the influence of steel-scrap additions to the cupola are of considerable interest.

These data refer to tests carried out in acid- and basic-lined cupolas. The samples for gas analysis were taken from metal flowing from a 10-ton receiver. Small chilled samples were taken using the graphite mould illustrated earlier in this Report. Each cast from the acid-lined cupola was of 10-tons weight and successive casts were sampled during a continuous period of working of 10 hrs. Five sets of samples were obtained over two days of working in the acid-lined cupola. In the basic-lined, water-cooled cupola, two successive 6-ton casts made on the same day were sampled. Priestman coke was used throughout the tests and the metal : coke ratio was 8 : 1. Ferro-alloys were added to the cupola as necessary to achieve the desired final composition.

The results obtained are given in Table XVI; they appear to indicate that a higher percentage of steel scrap in the charge leads to a higher nitrogen content in the final irons. The all-steel-scrap charge, whether melted in the acid-lined or the basic-lined cupola, gave the highest nitrogen content, approximately 65 to 75 p.p.m.

In view of the interest which the results on nitrogen aroused, a chemical method for the estimation of this element was investigated[2] and shown to give results checking those obtained by vacuum fusion. This method requires a laboratory free from nitrogeneous and particularly ammoniacal fumes, and requires a good deal of care and practice to obtain reproducible results, but no very elaborate or unusual equipment is required.

Hydrogen in Cast Iron

Thus far, little attention has been paid to the results obtained for hydrogen content by vacuum fusion. Hydrogen is known to diffuse very rapidly through heated iron and can easily be lost (or absorbed) during the cooling of a casting. It is not safe to assume that the hydrogen content of a sample obtained by normal casting techniques is the same as that of the liquid metal from which it was cast. Hydrogen diffuses through steel at room temperature and is to be expected to behave similarly in cast iron. Most of the vacuum-fusion samples commented on so far in this Report had to be stored for some time before they could be analysed and the amount of hydrogen lost or absorbed during this time is problematical.

In the vacuum-fusion technique, the hydrogen evolved may be a small part of the total gas and the accuracy of its estimation is then low. Bach[3] rarely found hydrogen contents greater than 0.0002 per cent. (2 p.p.m.) in samples from industrial furnaces, and Bach, Dawson and Smith[4] only claim reproducibility of ± 0.00007 per cent. (± 0.7 p.p.m.) for this vacuum-fusion technique.

Experience with steels had already indicated that

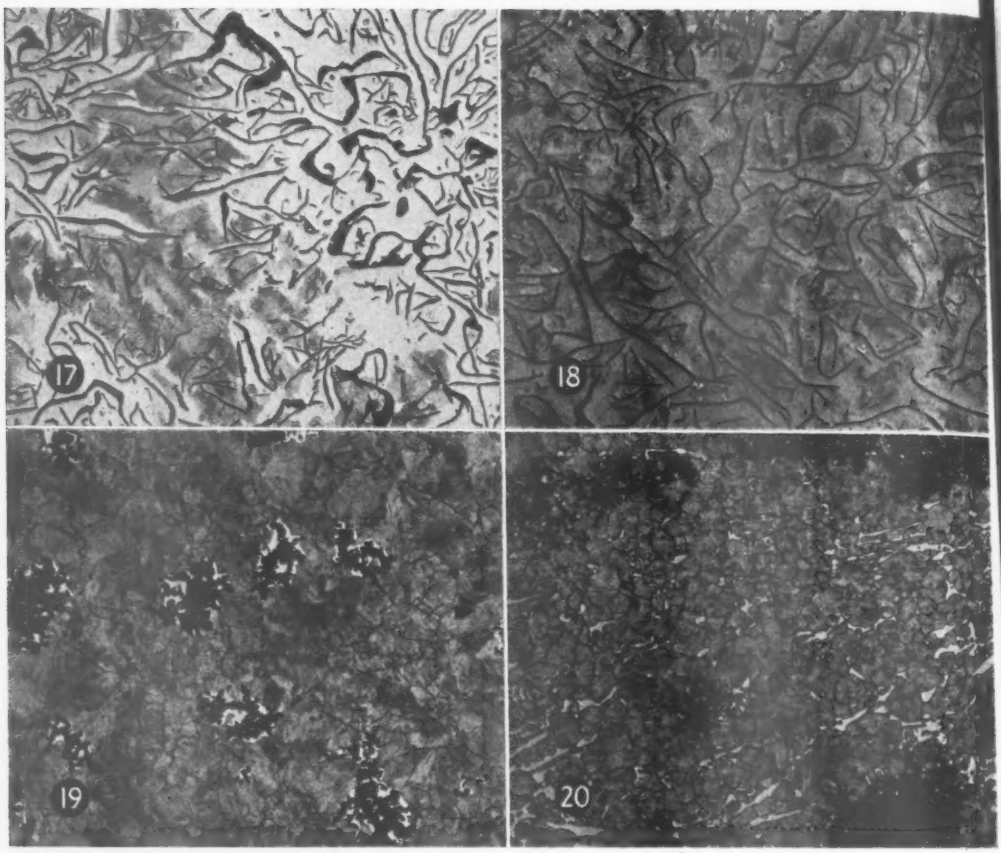


FIG. 17.—*General structure of* 1.2-*in. dia. bar having nitrogen* 50 *p.p.m. Etched in picral;* × 100 (*after Dawson, Smith and Bach*[1]).

FIG. 18.—*General structure of* 1.2-*in. dia. bar having nitrogen* 175 *p.p.m. Etched in picral;* × 100 (*after Dawson, Smith and Bach*[1]).

FIG. 19.—*Sample malleablized at* 950 *deg. C. for* 48 *hours; nitrogen* 70 *p.p.m. Etched in picral;* × 100 (*after Dawson, Smith and Bach*[1]).

FIG. 20.—*Sample malleablized at* 950 *deg. C. for* 48 *hours; nitrogen* 470 *p.p.m. Etched in picral;* × 100 (*after Dawson, Smith and Bach*[1]).

the procedure known as vacuum-heating might be a suitable method for the determination of hydrogen in cast irons. This technique involves the heating of a suitable sample in vacuum at a temperature of 600 to 1,000 deg. C. Under these conditions, hydrogen is the major gas evolved and in steels, at least it is known that substantially all the hydrogen could be removed by this procedure.

Bach[27] has studied the evolution of hydrogen from cast irons at room temperature and has described a suitable technique for this, involving storage in vacuum and collecting the gas evolved. He found that hydrogen was evolved from all types of chilled sample, but the quantities obtained varied greatly with cooling-rate and composition. The more rapid the cooling of the sample, the more rapid the hydrogen evolution. Sand-cast grey irons evolved some gas during the first few hours of storage in vacuum but no hydrogen was evolved. This initial evolution was thought to be due to air adsorbed on the surface of the specimen. Re-exposure to the air gave a similar evolution of gas. With chill-cast samples, the hydrogen evolved after six months amounts to about a third of the original total hydrogen content of the sample. From otherwise comparable samples, the rate of hydrogen evolution was less when the as-cast skin was not removed by machining.

Hurst and Riley[28] made a preliminary study of the application of the vacuum-heating technique to cast irons using samples of grey irons. They con-

cluded that the method did not work very satisfactorily for such materials, and found that the gas evolved at 600 to 800 deg. C. was not predominantly hydrogen, but also contained appreciable amounts of carbon monoxide and nitrogen. Furthermore, not all the hydrogen was removed by treatment in this temperature range and further amounts of all gases were obtained on raising the temperature and by exposing the specimen to the atmosphere again.

Bastien[29] has made a very useful review of all the information available on hydrogen in cast irons, compared with steels. He has discussed the vacuum-heating technique and has suggested that hydrogen evolution might be complete at 1,100 deg. C.

More recently, Bach[27] has made a careful study of the vacuum-heating technique and has developed an improved apparatus which enables the progress of hydrogen evolution to be followed and which is more sensitive than has been used before for cast irons. This investigator has used this apparatus to study the effect of temperature on the rate of hydrogen evolution for chill-cast and

TABLE XVI.—*Influence of Steel Scrap in Cupola Melting.*

Cast No.	Percentage steel-scrap content of cupola charge. (Steel stampings.)	Chemical analysis, per cent.					Gas analysis.		
		T.C	Si	S	P	Mn	Hydrogen, p.p.m.	Oxygen, p.p.m.	Nitrogen, p.p.m.
				Acid-lined cupola					
1	8.33	2.96	1.57	0.064	0.16	0.83	2.0 2.1	20 28	48 40
							av. 2	24	44
2	25	2.96	2.09	0.066	0.17	1.03	2.1 2.0	25 24	50 52
							av. 2	24	51
3	50	2.88	1.87	0.060	0.16	0.78	1.9 2.1 2.0	31 25 26	55 50 54
							av. 2	27	53
4	75	2.9	1.80	0.072	0.16	0.74	2.0 2.2 1.9	30 37 30	57 62 60
							av. 2	32	60
5	83.33	2.82	1.61	0.080	0.12	0.68	2.1 1.9 2.0	32 30 31	66 65 62
							av. 2	31	64
6	100	2.88	2.08	0.060	0.12	1.00	1.9 2.0 2.1	40 45 40	71 69 72
							av. 2	42	71
				Acid-lined cupola.					
1	25	3.00	2.12	0.048	0.10	1.00	2.0 2.1	9 12	47 42
							av. 2	11	45
2	50	2.92	2.00	0.080	0.14	0.90	1.6 1.9	23 20	43 47
							av. 1.7	21	45
3	75	2.90	1.83	0.050	0.20	1.04	1.4	11	47
4	83.4	2.86	2.11	0.062	0.17	0.77	1.9 1.9	14 21	37 40
							av. 1.9	18	39
5	100	2.90	3.96	0.076	0.063	1.23	3.2 3.2	13 20	78 70
							av. 3.2	17	74
				Basic-lined, water-cooled cupola.					
1	100	3.55	1.53	0.020	0.066	0.58	2.1 2.0	40 42	70 60
							av. 2	41	65
2	100	3.59	0.58	0.012	0.042	0.47	1.9 2.0	55 45	71 70
							av. 2	50	70

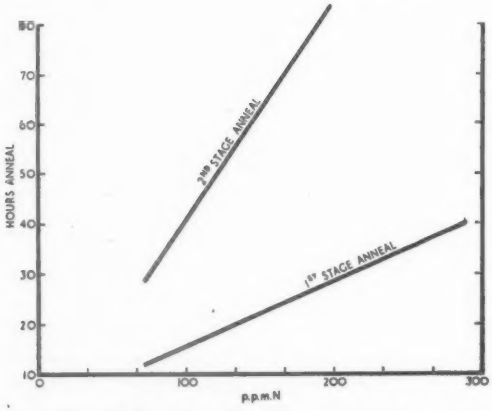


FIG. 21.—*Illustrating the influence of nitrogen on the rate of graphitization of malleable iron (after Smith, Bach and Dawson[5]).*

sand-cast samples. He has concluded that the evolution of hydrogen is complete for chill-cast white irons when held at temperatures of 650 to 750 deg. C., or at temperatures above 1,000 deg. C. for 2 hours. Below 650 deg. C. and at 750 to 1,000 deg.C. evolution is not completed in 2 hours. Evolution of hydrogen from grey iron does not appear to be complete at any temperature studied. At each temperature, grey irons give an initial rapid evolution followed by a very slow evolution. The rate of hydrogen evolution was found to increase for all samples by increasing the surface-to-mass ratio of the specimen.

The apparatus developed by Bach gives figures for hydrogen only, but for this element it appears to be able to detect variations in hydrogen evolved representing 0.0000001 per cent. (0.001 p.p.m.) hydrogen in the sample.

At the moment it appears that the vacuum-heating technique as described by Bach will be satisfactory for hydrogen estimations and, provided a satisfactory sampling technique can be developed, it will enable a more precise survey of the influence of hydrogen variations in liquid iron to be investigated. Sampling techniques are at present being studied.

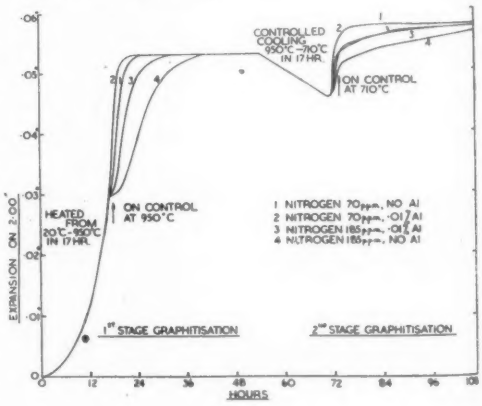
The Joint Gases Committee had the surveillance of a programme of fundamental work on the solubility of hydrogen in iron/carbon, iron/carbon/silicon alloys and cast irons. This work was carried out at Cardiff University College under the supervision of Mr. Evans. The first report on this investigation was made available for the last annual meeting of the Institute.[39] This gave figures for the equilibrium solubility of hydrogen in iron/carbon alloys of carbon content up to 3.4 per cent. and for temperatures of 600 to 1,000 deg. C. It was found that carbon in the range 1.5 to 3.5 per cent. did not greatly influence the solubility of hydrogen in iron/carbon alloys. At 1,000 deg. C. an alloy having 3.0 per cent. of carbon could dissolve about 0.0007 per cent. (7 p.p.m.) hydrogen. The solubility decreased with decreasing temperature, falling to about 0.0001 per cent. (1 p.p.m.) at 600 deg. C. In all cases there was a fairly sharp drop in hydrogen solubility when austenite transformed on cooling. The results obtained are summarized in Fig. 23, taken from the paper by Davies and Evans. The object of this fundamental work is to provide a background of equilibrium data so that the extent to which normal solid cast irons are saturated with hydrogen may be judged.

CONCLUDING REMARKS

This Report should make it clear that considerable work has been carried out on gases in cast iron, but very much further work remains. Molten metal may be sampled and satisfactory figures for oxygen, nitrogen, and hydrogen contents obtained, although more work is required in connection with sampling for the latter element. The investigators seem inclined to the view that rapidly-cooled chill-cast samples are most suitable for obtaining information about the gas content of liquid cast irons and pig-irons. On cooling, the gas content of an iron may change. In general, the gas analysis of grey-iron samples gives anomalous results which cannot at the moment be explained. Gases are readily adsorbed on all metallic surfaces, particularly when these are rough. The surface area of samples for gas analysis must be kept to a minimum. Drillings are not suitable except for the chemical estimation of nitrogen. The total gas content of samples examined by vacuum fusion increases with surface area. It is partly for this reason that unsound samples are to be avoided. It is possible that grey-iron samples give anomalous results because of gas adsorbed on cavities and fissures associated with graphite flakes near the specimen surface.

The work carried out so far does not confirm the popular view that oxygen in cast iron behaves as a

Fig. 22.—*Dilatometer curves illustrating the neutralization of nitrogen by aluminium in relation to the graphitization of malleable iron (after Smith, Bach and Dawson[5]).*


CONTROLLED COOLING 950°C–710°C IN 17 HR.
ON CONTROL AT 710°C
ON CONTROL AT 950°C
HEATED FROM 20°C–950°C IN 17 HR.
1 NITROGEN 70 p.p.m., NO Al
2 NITROGEN 70 p.p.m., ·01 % Al
3 NITROGEN 185 p.p.m., ·01 % Al
4 NITROGEN 185 p.p.m., NO Al
EXPANSION ON 2·00"
1ST STAGE GRAPHITISATION
2ND STAGE GRAPHITISATION
HOURS

carbide stabilizer. It has not so far been possible to confirm all the claims made about "oxidized metal." In some cases at least, this condition has been shown to be due to a low-metal temperature. Melting under oxidizing conditions might remove small traces of graphitizing elements such as aluminium, giving a resultant carbide-stabilizing effect.

Nitrogen has been shown to be a carbide stabilizer, but the effect is neutralized by aluminium, the graphitizing effect of which may therefore be mainly due to its combination with nitrogen and not oxygen.

A survey has been made of the gaseous-element content of industrial irons made under many different conditions. The foundryman now has an idea of what is the normal average nitrogen and oxygen content for iron produced from typical ironfoundry melting units. Much more work should be carried out on this subject.

The relation between the gaseous-element content of the liquid iron and the soundness of iron castings is almost unexplored and this is the big task for the future, particularly with reference to hydrogen content.

The whole subject of gases in cast iron is one for which easy answers are rarely obtained. Many of the anomalies attributed to gas content variations may arise from variations in residual element content, variations in moulding procedure and materials, and

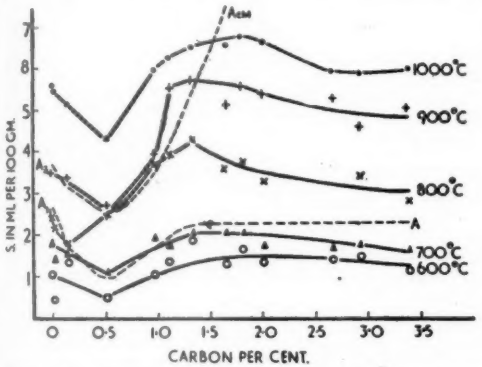


FIG. 23.—*Influence of carbon on the solubility of hydrogen at various temperatures in iron/carbon alloys (after Davies and Evans*[23]*).*

also to variations in melting cycle and pouring temperatures. These are factors very rarely under precise control in the foundry.

APPENDIX

The present membership of the Joint Committee on Gases in Cast Iron is:

Mr. H. Morrogh (chairman), British Cast Iron Research Association, Alvechurch, Nr. Birmingham.

Mr. B. B. Bach, British Cast Iron Research Association.

Mr. W. Y. Buchanan, John Lang & Sons, Limited, Johnstone, near Glasgow.

Mr. J. V. Dawson, British Cast Iron Research Association.

Mr. T. Evans, University College of South Wales and Monmouthshire, Department of Metallurgy & Fuel Technology, Cardiff.

Mr. N. Gray, Guest Keen Baldwins Iron and Steel Company, Limited, Port Talbot, Glam.

Mr. H. G. Hall, Castings, Limited, Walsall.

Dr. R. V. Riley, Staveley Iron and Chemical Company, Limited, near Chesterfield.

Mr. H. A. Sloman, National Physical Laboratory, Teddington.

Mr. L. W. L. Smith, British Cast Iron Research Association.

Mr. G. E. Speight, R.T.S.C., Central Research Laboratories, Aylesbury.

Mr. K. H. Wright, C. Akrill, Limited, West Bromwich.

Mr. G. Lambert (secretary), Institute of British Foundrymen.

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New Patents

(Copies of complete specifications are obtainable from the Patent Office Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2, price 3s.)

741,359. Climax Molybdenum Company, 500 5th Avenue, New York, USA.

A method of heating molybdenum-base alloys containing beryllium, the object being to provide cast molybdenum-base alloys capable of being hot worked, and cast molybdenum-base beryllium-containing alloys capable of being worked or machined and afterwards hardened by heat-treatment.

741,360. Climax Molybdenum Company, 500 5th Avenue, New York, USA.

Improvements relating to cast alloys of molybdenum and/or tungsten and aluminium. The patent relates more specifically to large, sound, cast molybdenum-alloy ingots capable of being hot worked by forging, pressing, rolling, or extrusion and other methods. These alloys are applicable to gas-turbine blades, components of turbo-jets and rockets, and die-casting dies for brass and other non-ferrous metals.

741,361. Climax Molybdenum Company, 500 5th Avenue, New York, USA.

Cast molybdenum-base alloys. The object of the invention is to provide cast alloys of molybdenum capable of being hot worked, which have an improved hardness and strength both at room or elevated temperatures. The alloys also have an improved intergranular cohesion of grains, a reduced grain size, and a lower specific-gravity than pure molybdenum. A typical composition would be molybdenum 70 or molybdenum and tungsten 70 per cent., the percentage of molybdenum being greater than the tungsten. An essential alloying element selected from group Va of the periodic system in such an amount as to produce an alloy having a hardness of 200 VPN at 1,600 deg. F. is added, *i.e.*, containing either vanadium 0.25 to 7, tantalum 0.50 to 9.0, or columbium 0.25 to 10 per cent.

741,381. Shaw Processes, Limited, 41 Carliol Street, Newcastle-upon-Tyne.

A method of producing metal casting moulds by pouring around a pattern, an investment. This consists of comminuted refractory material made into a slurry with an organic or inorganic sol (other than a sol produced from an alkyl silicate). This sol should be capable of setting to a refractory-oxide gel sufficiently firm to enable the mould to be handled when set. The investment is allowed to set, and the pattern is removed. This particular invention submits the mould after setting, but before any substantial shrinkage due to evaporation occurs, to thermal shock by the rapid application of even heat simultaneously to all surface particles of the moulds. The temperature should be in excess of that required to remove volatiles, whereby immediate freezing of the external dimensions is affected as well as the formation of a porous structure in the mass of the mould.

741,567. Guszstahlwerk Bochumer Verein, Aktiengesellschaft, Bochum (Federal Republic of) Germany.

A method of making high-grade steel wherein molten metal is purified by the action of slag. In this method the steel bath is contained in a closed vessel in which (after treatment with a gas containing at least 75 per cent. of oxygen), it is subjected under a strongly deoxidizing slag to a low absolute pressure which produces a strong agitation of the bath and hence an intimate mixing of the steel and the slag.

Notes from the Branches

Bristol and West of England

The meeting on November 19 of the Bristol and West of England branch of the Institute of British Foundrymen took the form of a film show and discussion on the use of resins in industry. Owing to illness, the place of Mr. Martin was taken by Mr. Love, who was thanked for stepping into the breach at very short notice.

The film demonstrated the many applications of resins in the foundry industry, particular interest being aroused by the sections on coremaking and even temporary patterns using resin. Replying to questions, MR. LOVE made the following points:—When skin drying resin-bonded moulds a torch is usually more effective than just a flame. Damp spots in resin-sprayed cores or moulds can be due to either excess resin over the amount of solvent, or excessive penetration of resin on sprayed surfaces. The contraction of resin-bonded cores is negligible, as is moisture pick-up with such material. No evidence is available that sulphur pick-up in the metal is found when using resins, but some superficial carbon pick-up is sometimes experienced.

Proposing a vote of thanks, MR. H. BALME said that much of interest has been shown and discussed through the medium of the film, and he thanked Mr. Love for the frank manner in which he had answered questions. The vote of thanks was seconded by MR. J. R. HAYWARD.

December Meeting

The meeting on December 10 was an interesting one at which Mr. G. J. Rogers presented his Paper "Foundry Problems and Principles." Dealing with many of the difficulties met with in foundries, the speaker showed by means of illustrations how such difficulties can be overcome by the application of commonsense and stressed the advantages to be gained by employing progressive solidification to castings whenever possible.

By careful attention to feeding conditions and the intelligent use of chilling, Mr. Rogers said, sound castings could often be produced which otherwise would frequently be found unsound. By looking after details, Mr. Rogers showed how consistently good results could be obtained on test bars in 88/10/2 gunmetal, a matter which proved of great interest to many members present, who were surprised at the comparative ease with which minimum tensile figures of 20 tons per sq. in. could be obtained.

Answering questions, MR. ROGERS said that, when pouring from a height, the entrapment of oxides in the metal could be avoided by plugging the runner until full. When using whirlgates, the oxides would usually be found confined to the central portion of the runner. Dealing with the knock-out properties of CO_2-bonded sand, it was claimed that this could be improved by the use of wood-flour—sawdust was too coarse. When using wood-flour in CO_2-treated sands, it was imperative that thorough mixing was practiced, the sand and wood-flour being added before the binder.

In proposing a vote of thanks, Mr. F. K. VICKERY said that all present were indebted to Mr. Rogers for throwing new light on many problems and his willingness to pass on to other foundrymen the benefit of his long experience in the industry. These views were echoed by Mr. J. R. HAYWARD, who seconded the vote of thanks.

Operation of Basic-Bessemer Converters

Factors Controlling Composition of the Melt

An investigation of factors controlling uniformity of composition of blown metal in the basic-Bessemer converter has been carried out in France under the auspices of the *Institut de Recherches de la Sidérurgie.*[1] The steelworks department of *IRSID* has been studying the problems in close co-operation with a number of steelmakers using the process, and the results indicate that basic-Bessemer operation is not in itself more irregular than any other technique, the essential being that the steelmaker be given adequate means of control to enable him to ensure satisfactory uniformity.

For seven years, efforts have been directed to the following problems:—(*a*) Investigation of bath movements in the converter and of the most favourable shape for the shell, in order to reduce splashing during the blow and to improve the efficiency of conversion; (*b*) investigation of raw materials, including pig-iron and lime, but particularly the regulation of the pig-iron silicon content; (*c*) means of controlling the operation, so as to ensure satisfactory regularity in the quality of the steel.

Investigation of Bath Movements

Study of factors likely to cause splashing was carried out simultaneously with scale models, the principle conclusions being as follow:

Physical Factors.—(*a*) The static depth of the bath must be as shallow as possible, and in any case less than 60 cm. (about 2 ft.) in the case of a new lining, and this leads to converters being of large diameter; and (*b*) the blowing zone, as defined by the circle of the extreme outer tuyeres, must be as large as possible, which means enlarging the bottom of the vessel, so as to reduce to a minimum what was for a long time known as the "section of external circulation," a ring of which the major diameter is that of the cylindrical part of the lining and the minor diameter that of the blowing zone.

Investigation has shown that in the converter the bath is animated by a rotating movement lasting about 2 secs. in the case of 20- to 30-ton converters, and that this movement is not circulation but rather a rotating wave. Under certain conditions, the crest of this wave goes beyond the lower rim of the mouth and is projected outside it by the blast, thus giving rise to splashing. The height of the wave crest, other things being equal, is less if the static depth of the bath is shallow; also the wave diminishes with increasing blowing zone.

Thus as already indicated, the investigators arrived at the design of a converter of which the inside diameter is such that the static depth with a new lining remains less than 2 ft., the bottom being as wide as possible. The depth of the lining and the diameter of the mouth opening are also important, but are less so in a converter with a large-diameter bath than they would be if they were dimensioned proportionately

Physico-chemical Factors.—Workers attempted to explain why intense splashing, when it does occur, appears during the earlier period of decarburization. During this period of the blow, the silicon and a part of the manganese become oxidized first. The silica joins the iron and manganese oxides to form a primary slag which is a powerful foam-forming agent. This frothy slag, in suspension in the metal charge, causes the latter to swell progressively and splashing may occur. Thus, the dangerous period occupies the earlier period of decarburization. Progressively, the lime, inactive at the beginning, becomes heated sufficiently to neutralize the silica in the form of bicalcium silicates. The frothy primary slag then disappears, as does also the tendency to splash.

In order to avoid the splashing, it is advisable to use:—(*a*) Pig-iron with as low a silicon content as possible; (*b*) lime in small lumps, the surface of which is poor in silica and fairly porous, characteristic of material that has not been supercalcinated.

Raw Materials

What is necessary above all to ensure regularity of the basic-Bessemer process is uniformity both in quantity and quality of the raw materials charged into the converter. With regard to quantity, the pig-iron is now weighed in all steelworks. This was not always the case in the past with respect to lime and scrap, which were often merely estimated. To-day most steelworks are equipped to weigh all materials accurately. The problem of ensuring uniformity in the quality of raw materials is much less simple to solve.

Quality of the Pig-iron.—In a given works, the C, Mn and P content of basic pig-iron does not undergo any considerable fluctuation. This is not true, however, of the Si and S content or of the temperature of the pig-iron. The quantity of silicon and the temperature at the time of charging to the converter are essential factors of the thermal equilibrium of conversion, while sulphur has an important influence on the quality of the steel.

In steelmaking, uniformity of the silicon content of the pig-iron can be ensured by prerefining with pure oxygen in the ladle. During tests extending over four years, *IRSID* experimented with a whole series of different methods and collected the results peculiar to each of them. Eliminating the combined use of water vapour, the technique finally selected was that involving the injection of pure oxygen at a pressure of from 10 to 15 kg./sq. cm. (140 to 210 lb. per sq. in.) in the presence of a suitable addition of lime, by means of a jet nozzle which does not penetrate into the pig-iron. A pilot plant for precipitating the particles of iron oxides contained in the reddish brown smoke given off during the melt proved entirely satisfactory, with an efficiency exceeding 98 per cent.

Using a series of pig-irons whose silicon content on leaving the blast furnace ranges, for instance, from 0.25 to 0.80 per cent., pre-refining in the ladle permits of reducing the content at the time of charging into the converter to between 0.25 and 0.40 per cent., while ensuring the benefit of an appreciable rise in temperature. This intermediate operation between the blast furnace and the steel-

works can easily be introduced in existing plants. With regard to reduction of pig-iron sulphur in the ladle, experiments and tests are to be made either with a view to improving the efficiency of carbonate of sodium treatment or to replacing it by desulphurization of the lime in a rotary furnace according to Prof. Kalling's process.

Quality of the lime.—The quality of the lime charged in the converter influences not only splashing, but also dephosphorization conditions and the sulphur content of the steel. For instance, it has been shown that a pig-iron from which steel containing 0.03 per cent. S can be obtained with a lime having a sulphur content of 0.10 per cent. will yield a steel with 0.045 per cent. S at least if the lime contains 0.30 per cent. S, which is not exceptional.

Systematic investigations in this field have shown that the quality of the lime is an important factor in securing uniformity in the manufacture of basic-Bessemer steel, and that a good steel lime should have the following characteristics:—(*a*) It should contain as little silica and sulphur as possible, in particular, in should be free of dust collected during transport, or silo dust, both of them rich in silica and sulphur; (*b*) lime should not be in large lumps, and therefore should be crushed; (*c*) over-calcination should be avoided as it increases surface compactness excessively; (*d*) lime should not contain too large a proportion of uncalcined substances.

Control of the Basic-Bessemer Process

When the charge of pig-iron, with lime and other additions have been placed in the converter, the blow commences. For 70 years the sole means of control available to the operator were the pressure gauge, showing the blast pressure, his chronometer, and the appearance of the flame. Now, the quantities of importance for the operator are the following: (*a*) The quantity of oxygen which has passed through the charge since the beginning of the blow; (*b*) flow of air at any given time; (*c*) temperature of the bath at all times, and more especially at the time of final tilting and emptying of the converter; (*d*) approximate phosphorus content of the bath when the blow has to be stopped.

It is easy to understand that knowledge of all these data can ensure uniformity of steel. For instance, there are times when it is highly important that certain oxidizing additions, such as ore or limestone flux, be made at the proper moment during the blow. Thanks to an oxygen meter, this addition can be made at a moment which is accurately repeatable.

When the blast no longer consists of ordinary air, but of oxygen-enriched air or even of rich mixtures such as oxygen + carbon dioxide or oxygen + steam, it becomes necessary to know the various values. Provided the blow be very closely controlled, nitrogen contents of between 0.005 and 0.007 per cent. and prosphorus contents of less than 0.035 per cent. can safely be guaranteed.

Thus *IRSID* has developed and recommended a number of control apparatus and methods:—

Volume/flow graph.—This permits blowing perfectly repeatable successive charges and of making cooling additions during the blow at precisely the required stage of conversion. When the blast consists of only air, the volume/flow graph is an output meter combined with an air meter. The curve of flow is plotted according to the volume of air blow without regard to time.

When the blast consists of enriched air or of rich mixtures, the volume/flow graph can comprise a number of flow-graphs the diagrams representing the volume of oxygen passed since the beginning of the blow. In addition, it is fitted with an oxygen meter. The meter combination can be used as an automatic proportion regulator.

Control of Bath Temperature.—The final temperature of the bath, after tilting the converter, can be measured by means of the immersion pyrometer, which is quite accurate; but this type of measurement is impracticable during the blow. For this reason an optical pyrometer, sighting through a hole in the bottom of the converter, has been developed by *IRSID* and can give a continuous record of the bath temperature during the blow.

Blowing period.—To obtain a desirable phosphorus content of the steel necessitates great precision in stopping the blow. Hitherto the operator relied on the appearance of the flame and, as a precaution, usually tilted the converter a little too soon, at the risk of having to tilt it back again for a few seconds in order to complete dephosphorization.

The oxygen meter of the volume/flowgraph permits tapping the charge at the precise time when the desired phosphorus content is obtained, provided a certain number of conditions be complied with. There must be no leakage in the feed circuit of blast air; the quantity of pig-iron charged must be constant and its composition uniform; the temperature of bath should be the same at the end of each blow. A stop signal is now available based on variation in the opacity of the flame at the end of the blow, the instrument plotting a curve of opacity.

Conclusion

In spite of the speed of the basic-Bessemer process, it has become possible to control it to close limits. It is true, however, that the conduct of the blow demands an operator with new qualifications compared with his predecessors. To his capacity for observation, which he must retain, the operator must now add the capacity to interpret curves or dial indications. Thanks to the improvements made in the form of the converter and the uniformity of the raw materials, and to closer control of the blow, the operator can now keep nearer the thermal equilibrium of successive charges and exercise greater precision in stopping the operation, thus assuring uniformity in the quality of the steel. The apparent instability is not a congenital defect of the basic-Bessemer process. It is amenable to remedies which must be carefully administered.

REFERENCE

[1] P. Leroy. "An Investigation of Factors Affecting the Regularity of the Melt in the Basic-Bessemer Operation." Paper (here abridged) discussed at Hagondange, France, during the visit of the Joint Metallurgical Societies in Europe.

New Equipment

Two-way Valve for Material Handling

A problem frequently encountered in the control of bulk dust and waste handling is the difficulty of diverting the flow of material from one duct to another. Dallow, Lambert & Company, Limited, Spalding Street, Leicester, have recently introduced a modified two-way control valve for use in dust-control systems. Fig. 1 shows the new device, which is identified as the KC model control valve. It can be used with all types

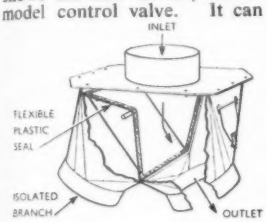

FIG. 1.—*KC two-way control valve.*

of dusts, chippings, wood waste, etc., and will operate fitted in any position. Basically, the device consists of a "Y" piece containing a metal chute which can be pivoted to direct the flow of gas and material as required.

The profile of the chute has been designed to present minimum resistance to flow; this fact minimizes any tendency for build-up of solids in the valve. The branch of the valve isolated by the chute is sealed by durable flexible plastic seating. Where fibrous materials are being handled—with the possibility of material clinging to the edge of the chute during change-over—the flexibility of the plastic joint enables a dust-tight seal to be maintained around the obstruction until the next change-over allows the material to be carried clear. By virtue of the simplicity of design and robust construction, it is claimed that the valve will give long and trouble-free service. It is made in a range of sizes to fit ducting of from 4 to 22-in. dia.

Roller Girder Clamp

Originally designed for use in the mining industry, the patented girder clamp, Fig. 2, by S. E. Williams (Patents), Limited, Pedmore, Stourbridge, in its latest form incorporating runners, can be used in every industry or trade where quantities of material or weighty articles need to be transferred from point to point in works or factory, either as part of loading, conveying or processing set-ups.

The two outstanding features of the clamp are, first, its positive but simple locking action when the weight is applied, and, second, the ease with which it can be removed from the girder at any desired point and immediately transferred to any other part of the conveying system without necessitating any interruption to a "run" of processes, and completely obviating the necessity of "running" back the clamps to the commencing point.

FIG. 2.—*Roller girder clamp designed for use where quantities of materials or weighty articles need to be transferred from one place to another.*

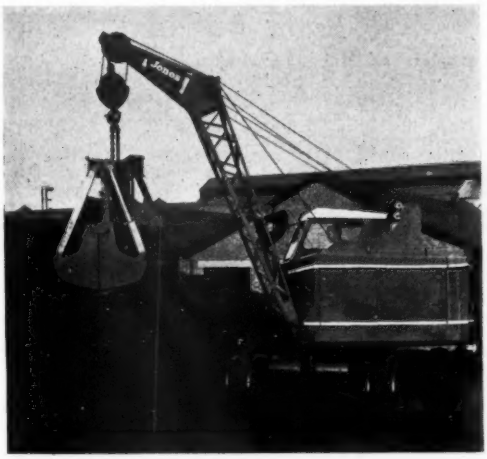

FIG. 3.—*K. & L. Steelfounders' mobile crane model KL 33.*

Mobile Crane

K & L Steelfounders & Engineers, Limited, Letchworth, Herts, have just placed on the market a new model (Fig. 3) known as the KL 33. As an addition to their range of cranes it is midway between the KL 15 (¾ ton) and the KL 44 (4 tons), and has a lifting capacity of 3 tons. The machine is powered by a Petters diesel-engine and employs a direct mechanical drive, thereby enabling full engine power to be applied to each drive. There is a choice of jib—either channel or lattice construction, or, if desired, special jibs such as the swan-neck or cantilever-type can be fitted. The wheeled chassis can have either two- or four-wheel differential drive. It is stated that this is the first time that the latter type of drive has been made available on a standard mobile-crane chassis of any type. The turning circle has thereby been reduced to 13 ft. The superstructure, of course, turns through 360 deg.

This range of cranes can lower with creeping speeds in every way equal to those specially designed for foundry use. Indeed such is the degree of precision that they can crack an egg without breaking it. Mobile cranes are popular in British foundries, but it is stated that in America there are three times as many used, calculated on an equivalent basis. The K & L concern certainly "takes its own medicine" for there are quite a number of their cranes servicing their foundries.

ALLIED INDUSTRIAL SERVICES, LIMITED, Lidget Green, Bradford, 7, have organized a machinery cleaning-cloth service. Under the scheme cleaning cloths specially constructed for maximum absorbency are supplied on loan to firms, together with metal storage containers. Regular deliveries of clean and serviced cloths are maintained direct by the supplier's own transport and the soiled cloths are picked up as they become available, weekly or fortnightly.

Book Reviews

Kupfer und Kupferlegierungen (Copper and Copper-alloys) by H. Keller and K. Eickhoff. Published by Springer-Verlag, 20, Reichpielschafer, Berlin, W. 35, Germany. Price, DM 3.60.

This little book is the third but completely re-written edition of the late Dr.-Ing. R. Hinzmann's book *Nichteisen-Metalle, part* 1. It remains under its new heading, *Kupfer und Kupferlegierungen,* within the series of workshop-books (Werkstattbücher, Heft 45) published by the Springer-Verlag. A comparison with the previous editions, 1931 and 1941, reveals that the latest German standard specifications (Normblätter, DIN) have been taken into consideration for all copper-base alloys mentioned, and the DIN-tables as published will be very welcome to those who have to deal with German alloy specifications. A new section: "Surface Treatment of Brass" has been added and a chapter on nickel-silver and cupro-nickel follows the discussion of high-tensile brasses. It is of interest to note that the approximate German equivalent to the British standard specification BS 1400-AB 1 is called "iron-aluminium-bronze," even if the nickel content is up to 1 per cent. Ni, whereas the description "nickel-aluminium-bronze" is reserved for aluminium-bronzes with 8.5 per cent. Al, 3 to 6 per cent. Ni and 2 to 6 per cent. Fe, the equivalent specification to BS 1400-AB2. The chapter on gun-metals is essentially unchanged and the nearest German specification to the British Admiralty gunmetal 88/10/2 remains the German Rg 10 with 9 to 11 per cent. Sn, and up to 4 per cent. Zn. The next lower German standard gunmetal is already Rg 5 with 5 to 6.5 per cent. Sn, up to 7 per cent. Zn and 3 per cent. Pb, which compares with BS 144-LG 2 (85/5/5/5).

The book is well arranged and illustrated and can be regarded as the German counterpart to publication No. 43 of the Copper Development Association, *Copper and its Alloys in Engineering and Technology.*

O.P.E.

Mechanical World Electrical Year Book, 1956: published by Emmott and Company, Limited, 31 King Street West, Manchester, 3. Price 3s. 6d. net.

In this edition there is a new section dealing with electronics, the applications of which increase almost daily. The section includes consideration of thermionic valves and their accompanying equipment, which are now found in use with spot welding, high-frequency generating, induction and di-electric heating and light control. The balance is made up of the usual contents having perennial interest.

House Organs

"600" Vol. 29, No. 132. The magazine of George Cohen Sons and Company Limited, Cunard Works, Chase Road, London, N.W.10.

What should be of main interest to our readers in this issue is a well-written article by Mr. Frank Rowe on "Quality in Steel Castings," but with "600" there is always the tendency first to turn the funny stories and humourous pictures. Yet Mr. Rowe's article is worth careful study, especially as to his remarks on the economics of the steelfoundry industry. After reading this article one is convinced that only by research and meticulous supervision can the industry give the service which the engineer must have from it.

QUASI-ARC, LIMITED, of Bilston, Staffordshire, announce that they are now sole licensees in this country and the Commonwealth for Heliarc welding equipment.

Publications Received

Dunlop Research; published by the Dunlop Rubber Company, Limited, St. James's House, St. James's Street, London, S.W.1.

This truly magnificent 80-page brochure certainly uses the word "research" in its widest sense. It ranges from the fundamental to wearing tests on shoe soles, and the drive of a golf ball. The word is as elastic as the product, as some are very interesting empirical tests, whilst others are essentially scientific. The coloured illustrations are beautifully printed, whilst the letterpress has been clearly and simply written so that the layout receives a splendid impression of the great quantity and wide variety of the experimental work undertaken. The Dunlop publicity department deserve high commendation on the successful culmination of their efforts.

Sondes Place Research Institute; issued by the Sondes Place Research Laboratories Limited, Dorking, Surrey.

This 16-page brochure describes and illustrates the services available for carrying out sponsored research and development in chemistry, and chemical and mechanical engineering. The Institute has been established seven years. Amongst the names appearing on the board of directors is that of Major F. A. Freeth, F.R.S., a past-president of the British Cast Iron Research Association. The list of researches carried out includes work on precision investment casting and cast iron. The equipment illustrated is in every way suitable for chemical and physical investigations. The booklet is available to readers on writing to Dorking.

Hand and Machine in the Country, being the 1954-55 Annual Report of the Rural Industries Bureau, 35, Camp Road, Wimbledon, London, S.W.9. Price 1s. 6d.

This Bureau is a sort of development department sponsored by the Government. It spends about £120,000 a year in showing the rural worker how to cost, instead of guess; to introduce newer and better tools. A wide variety of trades is catered for, ranging from the blacksmith, hand brickmaking, saddlery, basketry to underwood—that is the job of making wattle fences and the like. It would appear that good work is being done in fields where neglect would probably result in obsolescence of time-honoured and interesting crafts.

New Catalogues

Telescopic Tilting Electric-fork Trucks. The British materials handling division of the Yale and Towne Manufacturing Company, Wednesfield, Wolverhampton, have issued four four-page leaflets carrying dimensional outline drawings and specifications of models of 1,500; 2,000; 2,500; and 3,000-lb. capacity. The reviewer wonders why four separate leaflets were necessary as he believes with a little ingenuity one could have been made to serve. These leaflets are available to readers on writing to Wednesbury.

Dust Collectors. Davidson and Company, Limited, Sirocco Engineering Works, Belfast, have embellished the front cover of a six-page folder with a small-scale reproduction of the title page of the Clean Air Bill as presented to the House of Commons. It certainly makes an apt introduction for a leaflet covering their "R"-type dust-collector.

Company News

BILSTON FOUNDRIES, LIMITED—The directors have declared an interim dividend of 7½ per cent., less tax, in respect of the year ending March 31, 1956, on the present ordinary capital of £280,000. Last year 10 per cent., less tax, was paid on £140,000.

UNITED GAS INDUSTRIES, LIMITED—Arrangements were recently completed for the placing of the company's loan stock. The issue of £600,000 6 per cent. unsecured loan stock, 1973-75, has been placed at 99, payable as to 50 per cent. on allotment and 49 per cent. on January 13.

WADKIN, LIMITED, makers of woodworking machinery and patternshop equipment, of Leicester—The company is acquiring a group of four woodworking machinery manufacturers by the purchase on January 2 of the share capital of J. Sagar & Company, Limited, Halifax, which has three subsidiary companies.

THOS. FIRTH & JOHN BROWN, LIMITED—The company is paying a final dividend of 6 per cent., making 9 per cent. for the year to October 1, against the forecast of an 8 per cent. total made when the £5,500,000 one-class ordinary capital was offered for sale by the Iron and Steel Holding and Realization Agency last March.

R. A. LISTER & COMPANY, LIMITED, agricultural, electrical, and general engineers and ironfounders, of Dursley (Glos)—Reporting record profits for the year ended September 30 last, the company announces a final dividend of 7½ per cent. This is as a year ago and again makes a 10 per cent. total. For 1953-54, however, the 2½ per cent. interim was paid before the 40 per cent. scrip issue. Subject to final audit, the group profit of £998,250 compares with £859,019.

VONO INDUSTRIAL PRODUCTS, LIMITED—Turnover in almost all sections of the group reached record levels during the 11 months to July 31 last, and with the total volume of orders on hand remaining high the current year is also likely to be one of great activity. Prices have been keen and profit margins narrow during the period, reports Mr. W. L. Barrows, chairman, and rising costs which cannot be passed on to customers will adversely affect 1955-56 margins.

EDWARDS HIGH VACUUM, LIMITED—The directors announce that the issue of 375,000 ordinary shares of 4s. each at 16s. 6d. per share has been taken up on provisional allotment letters to the extent of 374,638 shares. For the 362 excess shares, 325 applications for a total of 177,723 shares were received. In view of the small number of shares available for excess share applications and the difficulty of making any reasonable allotment, the directors decided that the most equitable course was to sell the 362 shares remaining and distribute the net premium to those originally entitled to them.

Contracts Open

The dates given are the latest on which tenders will be accepted. The addresses are those from which forms of tender may be obtained. Details of tenders with the reference ESB can be obtained from the Board of Trade Export Services Branch, Lacon House, Theobalds Road, London, W.C.1 (telephone: CHAncery 4411, ext. 738 or 771), unless otherwise stated.

BOOTLE (LANCS), January 7—Manhole covers, gully grates, etc., for the 12 months commencing April 1, 1956, for the Borough Council. The Borough Surveyor, Town Hall, Bootle.

INDIA, January 4—100-ton testing machine, for the Director-General of Supplies and Disposals, Government of India. (ESB/25942/55.)

SOUTH AFRICA, January 5—Abrasive wheel cutting-off machine, for the Union Tender and Supplies Board. (ESB/26959/55.)

Dorman Long's Profits Leap

A substantial increase from £6,541,130 to £8,797,220 in group profits is announced by Dorman, Long & Company, Limited, in respect of the year ended September 30, 1955. In view of the rise in the estimated cost of completing the major development programme and providing for working capital requirements, the board recommends an unchanged ordinary dividend of 8 per cent., less tax.

For the previous year an interim of approximately 2½ per cent. was paid on £7,515,243 capital and a final of 6¾ per cent. on the present capital of £15,000,000. The profit figures were struck after provisions for relinings, etc., of £551,462, against £120,318, depreciation of £1,746,708, against £1,530,258, and transferring £1,000,000 (nil) to fixed assets replacement reserve. Group net profit, after tax of £4,323,148, against £3,035,990, rose from £3,472,462 to £4,042,371.

Group profit includes substantial credits arising from increases in prices of trading stocks and the benefit of higher prices obtaining on export sales, as well as the effect of plants working up to and, in some cases, even above normal capacity. After deducting outside interests, but before taxation, the profit totalled £8,406,000 compared with £6,237,000 a year ago. The profits were made up as to:—Iron and steel, £4,818,000 (£3,119,000); bridge building and engineering, £3,302,000 (£2,853,000); chemicals, £286,000 (£265,000).

The directors state that controlled maximum prices of iron and steel products, which apply to home sales, are based on plants working at an average rate below normal capacity. Iron and steel prices take into account depreciation on fixed assets calculated to include some element of replacement cost, but in accordance with recognized accounting principles, the charge for depreciation in the accounts is related to historical cost. It has, therefore, been considered advisable for Dorman Long (Steel), Limited, to institute a fixed assets replacement reserve account and this year to allocate to it £1,000,000.

Steel and Pig-iron Output

Production of steel in November averaged 408,600 tons a week, which was the highest rate ever achieved. During the month output exceeded an annual rate of 21,000,000 ingot tons for the first time in the history of the industry. The previous highest weekly average was 401,600 tons last May.

Announcing the November figures, the Iron and Steel Board says that there is a good prospect that this year's steel production will reach 19,750,000 tons and that it is hoped to increase output next year to 21,000,000 tons.

Pig-iron production last month averaged 252,600 tons a week; this, too, was the highest rate achieved in any month.

The following table gives the latest steel and pig-iron figures (in tons) and compares them with earlier returns.

Period.	Pig-iron.		Steel ingots and castings.	
	Weekly average.	Annual rate.	Weekly average.	Annual rate.
1955—September	246,200	12,804,000	397,800	30,683,000
October	249,200	12,957,000	399,500	20,773,000
November	252,600	13,135,000	408,600	21,246,000
1954—September	222,900	11,591,000	372,000	19,358,000
October	230,700	11,998,000	374,500	19,472,000
November	235,300	12,236,000	377,000	19,606,000

News in Brief

A SEVEN-MAN RUSSIAN TRADE DELEGATION recently visited the Doncaster works of International Harvester Company of Great Britain, Limited, to inspect tractors and combine harvesters.

ABOUT 500 EMPLOYEES and friends of the Brightside Foundry & Engineering Company, Limited, attended the annual dance at the Cutlers' Hall, Sheffield, on December 14.

THIRTY-ONE EMPLOYEES at the East Hecla works of Hadfields, Limited, the Sheffield steelmakers, have received electric clocks for 25 years' service. Total membership of the Hadfield "25" Association is now 1,290.

G. BEATON & SON, LIMITED, Willesden, London, N.W.10, announces that the Albion Twist Drill & Tool Company, Limited, Brentford (Middx), is no longer a subsidiary as it has disposed of its entire financial interest in that company.

ARRANGEMENTS have been completed between Harland & Wolff, Limited, and Danly Machine Specialists, Inc., Chicago, USA, for the manufacture of machine power presses for the shaping of motor-car bodies at Harland & Wolff's Scotstoun, Glasgow, works.

AGREEMENT HAS BEEN REACHED, subject to the completion of formalities, for the acquisition by Tube Investments, Limited, of the whole of the issued share capital of the Power Centre Company, Limited. As is the usual practice in TI, the separate identity of the Power Centre Company will be preserved.

"THE VENGEANCE OF PRIVATE POOLEY," by Mr. C. A. Jolly, office manager of East Dereham Foundry, Limited, and based on the author's wartime experiences, is being published by Heinemann at the end of January. Although it is his first book, Mr. Jolly is well known in Norfolk for his shorter writings.

THE 31,000-ton d.w. ore carrier Ruth Lake, the largest vessel of her type yet built on the Tyne, has been launched from the Wallsend yard of Swan, Hunter, & Wigham Richardson, Limited. The vessel was built for the Iron Ore Transport Company, Limited, Canada, and will carry iron ore from Seven Islands.

A 60-ton 18-ft. dia. gear-wheel has been moved and re-installed by riggers of the English Steel Corporation, Limited, Sheffield, from the old armour-plate mill at Grimesthorpe to the River Don Works. It is to form part of the 12,000-h.p. steam-engine driving the rolls of the heavy plate mill. When the wheel was lowered on to its bearings at the River Don Works it fitted exactly.

A HOUSE-WARMING party was organized recently by Thermix Industries, Limited, to celebrate the completion of conversion of premises at Thermix House, Kingston-on-Thames, Surrey, into their new office block. The appointments, while not lavish, are on a scale and in taste well suited to the present status of the firm amongst the leading manufacturers of foundry and general ventilating plant.

MR. F. A. HURST, president of the Sheffield Chamber of Commerce, opened new premises of the firms associated with the Eadon Engraving Company, Limited, Shoreham Street, Sheffield, recently. Mr. A. Eadon, managing director, welcomed Mr. Hurst together with a company of 200 friends to the ceremony. The new premises will specialize in the production of printing plates, engraving work and precision machining.

MR. T. BURGAN, production manager of Wm. Turner (Kismet), Limited, pneumatic engineers, Eyre Works, Sheffield, recently received the Ashley S. Ward Trophy on behalf of the 200 employees for consistent savings in the works. The trophy—for the Sheffield firm with 100 to 499 employees, showing the best all-round effort in the year—was presented by Mr. Luther F. Milner, chairman of the Sheffield Savings Committee.

LORD DUDLEY GORDON, chairman of the board of Hadfields, Limited, steel manufacturers and engineers, East Hecla Works, Tinsley, Sheffield, welcomed guests to the annual dinner of the firm's Jubilee Staff Association, of which he is also chairman, in the works' canteen on December 16. All members of the Association have worked for the firm for 50 years and of the 97 members, 88 were present at the dinner. Of those present, 43 are still working for the firm.

THE FINAL MACHINING of an important forging for Holland's new 100-megawatt Amer Centrale Power Station, near Geertuidenberg, to be opened next October by Queen Juliana, has just been carried out in the south machine shop of English Steel Corporation, Limited, Sheffield. It is a high-tensile outlet superheater header in chrome-molybdenum steel with an 11-in. bore. It is 37 ft. long and 16 in. dia. It is one of two components ordered from English Steel Corporation, and the other has already been despatched.

THE PRESIDENT OF THE BOARD OF TRADE, Mr. Peter Thorneycroft, announced in the House of Commons earlier this month that he had appointed a departmental committee on hall-marking under the chairmanship of Sir Leonard Stone, O.B.E. The terms of reference of the committee are: "to examine the state of the law on the assaying and hall-marking of precious metals, and to recommend what revision of the law is desirable in the light of present day conditions." Organizations and persons who wish to give evidence to the committee are invited to write to the secretary of the committee, Miss B. Hirst, Board of Trade, Horse Guards Avenue, London, S.W.1, before January 31, 1956.

A DINNER WAS HELD at the Royal Hotel, Sheffield, on December 14, to mark the inauguration of the new magnet factory of James Neill & Company, Limited, in Napier Street, Sheffield. The firm was also celebrating its 21 years in the development of the permanent magnetic chuck. Mr. W. Leslie Bowers, the designer of the tool and father of its development, was presented with a silver salver upon which was inscribed the story of his part in the developing of the product. Colonel Neill, High Sheriff of Yorkshire, who made the presentation, said that magnetic aids to industry had gained an export of 36 per cent. of total output by competitive pricing. The permanent magnet chuck was a steady dollar earner. Twenty years ago Neill's output was 100,000 magnets monthly, in 1947 it was 250,000, and in September this year it was 560,797.

MR. J. B. FRIZELL, director of education for Edinburgh in a report (referred to briefly in last week's issue) on technical education, stated that whatever the requirements of the future might be there was an urgent need now for a well-designed centrally-situated building technical college, an engineering technical college, and a college of commerce. The proposals in the report were approved generally as a basis of further detailed reports by officials concerned. The planning of future technical college requirements, said Mr. Frizell, must take account of the fact that there was on the Statute Book a decision to introduce compulsory further education and training on one day each week for all young persons between 13 and 18 who were not engaged in full-time education. At present this section of the 1946 Education (Scotland) Act was being anticipated by an ever-increasing number of employers. There were at present 2,030 day release students who attended classes in the committee's day institutes.

Personal

MR. G. ANTHONY HEPWORTH has been appointed a director of Hepworth & Grandage, Limited.

MR. R. G. SIDDALL has been appointed lecturer in fuel technology and chemical engineering at Sheffield University.

R. B. Pullin & Company, Limited, gyroscopic engineers and scientific instrument manufacturers, of Brentford (Middx), has appointed Mr. R. K. DEANE as production controller.

Mr. J. N. M. LEGATE, sales manager of the industrial control department of the Metropolitan-Vickers Electrical Company, Limited, has been appointed assistant chief engineer of the department.

Mr. C. F. LAWRENCE KING, a director and general manager of the British Wagon Company, Limited, Rotherham, is the new chairman of the Sheffield branch of the Institute of Transport.

The appointment is announced of Mr. SAM BLACK as head of the publicity department of the British Electrical and Allied Manufacturers' Association in succession to the late Mr. J. J. Conlan.

SIR EDWARD C. BULLARD will retire from the directorship of the National Physical Laboratory on December 31. Pending the appointment of a new director, DR. R. L. SMITH-ROSE, director of radio research in the Department of Scientific and Industrial Research, has been appointed acting director.

Mr. STEPHEN GARVIN, of the overseas directorate of the Federation of British Industries, is visiting India early next year. He will report to the Federation's Overseas Trade Policy Committee on prospective Indian industrial requirements in the light of the second Five-Year Plan and on other matters important to British exporting industries.

Mr. J. MORGAN BLADES has been appointed resident engineer in Canada of Enfield Cables, Limited, Enfield (Middx). He took up his appointment on December 23 and will be located in Montreal. Mr. W. E. GARDNER has been managing director of Enfield Cables (Australia) Pty., Limited. Mr. Gardner has spent all his business life in the cable industry and for many years was associated with Siemens (Australia) Pty., Limited.

MR. FREDERICK PICKWORTH, chairman of the English Steel Corporation, Limited, and MR. S. M. DE BARTOLOME, joint managing director of Spear & Jackson, Limited, were elected members of Sheffield University Council under a special statute at a council meeting on December 16. Mr. Pickworth has been in the Sheffield steel industry since 1904 and was appointed junior warden-elect of the Cutlers' company last September.

SIR ERNEST LEVER (chairman, Richard Thomas & Baldwins, Limited) will succeed MR. A. G. STEWART (chairman and general managing director, Stewarts and Lloyds, Limited) as president of the British Iron and Steel Federation on January 1. At the last meeting of the Council of the Federation, Sir Andrew McCance, F.R.S. (deputy chairman and joint managing director, Colvilles, Limited) was appointed president-elect of the Federation for 1956.

W. H. Allen, Sons & Company, Limited, engineers, of Bedford, is developing the Atlas Works, Pershore (Worcs), which it acquired recently, as a self-contained unit for the design and production of the whole of the parent company's gearing products. Mr. H. N. G. ALLEN, who has the new project in hand, will act as general manager in addition to his normal duties. Mr. E. R. YOXEN has been appointed works manager, with Mr. T. P. JONES as chief engineer (gearing). Mr. C. W. HAYES, the company's chief steam turbine designer, has been appointed chief engineer (steam turbines) and head of the steam turbine design department.

Obituary

Mr. JOHN BONEHAM, founder of the Mansfield engineering firm of Boneham & Turner, Limited, has died at the age of 70, after a year's illness. Throughout his life he had been connected with the engineering industry. Mr. Boneham was awarded the M.B.E. in 1943.

THE DEATH on December 9, at the age of 56, of Mr. E. F. FOSTER, for many years a senior sales representative in the United Kingdom of George Kent, Limited, is announced. Mr. Foster joined the company in January, 1915, and later, although under age, served in the first world war, rejoining the firm towards the end of 1918 and working first in the production control and drawing offices.

THE DEATH is announced of Mr. Robert J. Shaw, at the age of 84; he was a life member of the Institute of British Foundrymen, having joined in 1907. Originally from Belfast, during the 1914 war he was foundry manager of Ferranti, Limited. About 1920, he left to take up a position with a firm which decided to discontinue their project, but paid proper compensation. With this, in partnership with the late Mr. Shannon, Ealing Park Foundry was formed, and became first a successful jobbing foundry, later turning to the manufacture of automobile castings. Next, Mr. Shaw took over the management of a firm in the Newcastle area. To help the 1939-45 war effort, Mr. Shaw, by then retired, took up a position as a draughtsman. During his period with Ealing Park Foundry, he was a very enthusiastic member of the London branch and was president in 1926-27. He was a good foundryman, a staunch friend and his passing will be much regretted by the older members of the industry.

THE DEATH HAS OCCURRED at the age of 84 of Lt.-Col. W. Carmichael Peebles, the eldest son of the late Mr. David Bruce Peebles, founder of Bruce Peebles & Company, Limited, the Edinburgh electrical engineering concern. Col. Peebles was educated at the Edinburgh Institution (later renamed Melville College), and received his engineering training at the Baldwin Locomotive Works in Philadelphia. He joined his father at the Hay Works, Edinburgh, in 1891, at which time the company was manufacturing gas governors and gas engines. In 1896 he was made a partner and with his brother, the late Mr. Arthur C. Peebles, was largely responsible for the development of the electrical side of the business. In 1908 the two sides separated with the formation of Peebles & Company, Limited, Hay Works, and Bruce Peebles & Company, Limited, East Pilton. The gas side of the works held Col. Peebles's interest, and he remained at Hay Works as director and manager until 1939, when he was appointed chairman and managing director. He retired from active management of the business in 1946, but remained a member of the board until he died.

Secretarial Change

There has been a change recently in the secretaryship of the National Foundry Craft Training Centre. The new secretaries are Heathcote & Coleman and correspondence and applications to send apprentices to the Centre should now be addressed to that firm at:—69, Harborne Road, Edgbaston, Birmingham, 15; telephone: EDGbaston 4141.

Raw Material Markets

Iron and Steel

Outputs of both pig-iron and steel ingots raised to the highest peak ever attained, home deliveries increased by 9.5 per cent. over the 1954 figure, and a rise of 17 per cent. in exports—that is the bright record of the iron and steel industry of Great Britain in the year now drawing to its close. Expansion of capacity has been speeded up to such an extent that the annual rate of crude steel production, which for the first time exceeded 21,000,000 tons in November, is expected to average that figure over the whole of next week.

The rise of 9,100 tons in the weekly production of pig-iron in November is largely accounted for by the lighting of the second new blast furnace at Shotton, with a designed capacity of 8,500 tons a week. Since then, the Dagenham furnace has restarted, and early in the new year there will be a further substantial increase in output when a still bigger blast furnace at Margam is started up. On the North-East Coast, also, two new large-diameter furnaces are nearing completion, but it is not yet possible to indicate when they will go into operation.

Outputs of castings from the engineering and speciality foundries continue to be on a good scale and there is every prospect of a continuance of the increase in production which they have so far obtained, provided sufficient pig-iron and scrap can be secured. The meagre supply of the low- and medium-phosphorus irons has been their chief worry, but some improvement in the supply of low-phosphorus irons should now be forthcoming, although it is unlikely to meet requirements fully.

Deliveries of hematite have improved from some sources, but other makers are still finding it impossible to meet all the demands made upon them.

Many of the light foundries are short of work. Restricted buying of many articles for which they supply castings and the substitution of other materials for cast iron, are adversely affecting their trade. The jobbing foundries are fairly busy, but most of the textile foundries are short of orders.

The foundries are taking up readily all arisings of heavy cast-iron and machinery scrap.

Although re-rollers have recently been receiving better deliveries of semi-finished steel, the position has been somewhat precarious and serious shortages must have occurred but for the regular arrival of fairly substantial tonnages of semis from western Europe. This source now shows signs of drying up. It is becoming more difficult to buy in European markets. Small billets are already scarce and the news of the expansion of ingot production is doubly welcome, since it opens up the prospect of increased supplies of billets, blooms, sheet bars, and slabs of British manufacture.

The expansion of capacity is not keeping pace with the growth of the demand for most finished steel products and buyers are lucky if they can get a place at the end of a long queue of consumers who are on the waiting list. A further expansion of plate production is promised, but the large-scale import of sheets will have to be continued indefinitely and pressure for joists and sections has been intensified, since Continental exporters are unable to quote.

The prices of refined irons have been raised by 6s. a ton. This increase follows the changes made by the Iron and Steel Board in hematite and other pig-iron prices in the week before Christmas.

Non-ferrous Metals

Continuation of the strike at the copper plants in Chile has pushed up the price of Custom smelter electrolytic copper to 50 cents a pound in the United States. The tonnage lost is already considerable, and copper is expected to remain tight and the price high until at least the end of the first quarter of 1956. The immediate settlement of the strike can hardly alter the position, which appears grim. On the London Metal Exchange activity has been considerably reduced in the copper market and the price has come down from its former peak level. One hard fact affecting the situation is the credit squeeze which is operative in one form or another in most European countries, thereby making it expensive to finance the holding of stocks.

The tin market in London retains its firm undertone, but in New York, the market is showing an easier tendency—possibly because tinplate consumers are still hesitating to build up their stocks in quantity at the present price level. The world output of tin concentrates in October totalled 15,100 tons, compared with 15,000 tons in September. Tin production in Malaya in 1955 is expected to exceed 60,000 tons. In November, output amounted to 4,993 tons, raising total production for the first 11 months of this year to 56,115 tons, against 60,691 tons for the whole of 1954.

The lead market on both sides of the Atlantic remains firm. In London the price has nudged the critical figure of £116 per ton, but there has been no price change in the US, where it is still quoted at 15½ cents a pound. Maintenance of a stable price in the US has been helped by heavy imports from Mexico.

Demand for zinc continues to be strong both here and in New York. The US price is still 13 cents, although the belief is spreading that there will be a price rise early in the New Year. Meanwhile, buyers are attempting to get more forward orders filled, but sellers are reluctant to go much beyond next month.

Official metal prices were as follow:—

COPPER, Standard—*Cash:* December 20, £400 to £401; December 21, £397 to £398; December 22, £390 to £391; December 23, £393 10s. to £394 10s.; December 28, £398 to £399.

Three Months: December 20, £394 to £394 10s.; December 21, £390 10s. to £391 10s.; December 22, £386 to £387; December 23, £389 to £389 10s.; December 28, £393 to £394.

TIN, Standard—*Cash:* December 20, £831 to £832 10s.; December 21, £828 to £830; December 22, £827 to £830; December 23, £828 to £829; December 28, £828 to £830.

Three Months: December 20, £811 to £812; December 21, £807 to £808; December 22, £808 to £810; December 23, £807 to £807 10s.; December 28, £807 to £808.

LEAD—*Second half December:* December 20, £113 15s. to £114; December 21, £114 to £114 10s.; December 22, £114 15s. to £115; December 23, £115 10s. to £115 15s.; December 28, £115 15s. to £116.

Second half March: December 20, £113 10s. to £113 15s.; December 21, £113 15s. to £114; December 22, £114 10s. to £114 15s.; December 23, £114 15s. to £115; December 28, £115 to £115 5s.

ZINC—*Second half December:* December 20, £98 5s. to £98 10s.; December 21, £98 10s. to £99; December 22, £98 15s. to £99 5s.; December 23, £99 to £99 5s.; December 28, £99 5s. to £99 10s.

Second half March: December 20, £95 15s. to £96; December 21, £96 5s. to £96 10s.; December 22, £96 10s. to £96 15s.; December 23, £97 to £97 5s.; December 28, £97 5s. to £97 10s.

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Current Prices of Iron, Steel, and Non-ferrous Metals

(Delivered unless otherwise stated)

December 28, 1955

PIG-IRON

Foundry Iron.—No. 3 IRON, CLASS 2:—Middlesbrough, £17 1s. 0d.; Birmingham, £16 13s. 3d.

Low-phosphorus Iron.—Over 0.10 to 0.75 per cent. P, £19 8s. 9d., delivered Birmingham. Staffordshire blast-furnace low-phosphorus foundry iron (0.10 to 0.50 per cent. P, up to 3 per cent. Si), d/d within 60 miles of Stafford, £19 8s. 3d.

Scotch Iron.—No. 3 foundry, £19 13s. 0d., d/d Grangemouth.

Cylinder and Refined Irons.—North Zone, £21 9s. 0d.; South Zone, £21 11s. 6d.

Refined Malleable.—P, 0.10 per cent. max.—North Zone, £22 6s. 6d.; South Zone, £22 9s. 0d.

Hematite.—Si up to 2 per cent., S. & P. over 0.03 to 0.05 per cent.:—N.-E. of England (local iron), £20 2s. 6d.; Scotland (Scotch iron), Zone S. 1, £20 9s. 0d.; Sheffield, £21 9s. 6d.; Birmingham, £21 17s. 0d.; Wales (Welsh iron), £20 9s. 0d.

Basic Pig-iron.—£17 8s. 0d. all districts.

FERRO-ALLOYS

(Per ton unless otherwise stated, delivered)

Ferro-silicon (6-ton lots and over).—45 per cent. Si, nominal, scale 14s. per unit; 35 per cent. Si, nominal, scale 39s. per unit.

Ferro-vanadium.—50/60 per cent., 23s. 8d. to 25s. 0d. per lb. of V.

Ferro-molybdenum.—65/75 per cent., carbon-free, 11s. 0d. per lb. of Mo.

Ferro-titanium.—20/25 per cent., carbon-free, £230 0s. 0d.; 38/40 per cent., £279 0s. 0d.

Ferro-tungsten.—80/85 per cent., 18s. 3d. per lb. of W.

Tungsten Metal Powder.—98/99 per cent., 21s. 3d. per lb. of W.

Ferro-chrome (6-10 ton lots).—4/6 per cent. C, £88 10s. 0d. to £95 0s. 0d., basis 60 per cent. Cr, scale 28s. 0d. to 32s. 0d. per unit; over 6 per cent. C, £87 10s. 0d. to £93 0s. 0d., basis 60 per cent. Cr, scale 28s. 0d. to 32s. 0d. per unit; 2 per cent. C,* 2s. 1d. per lb. Cr.; 1 per cent. C,* 2s. 1½d. per lb. Cr; 0.15 per cent. C,* 2s. 2½d. per lb. Cr; 0.10 per cent. C,* 2s. 2¾d. per lb. Cr; 0.06 per cent. C,* 2s. 3d. per lb. Cr.

Metallic Chromium.—98/99 per cent., 7s. 0d. to 7s. 6d. per lb.

Metallic Manganese.—93/95 per cent., carbon-free, £249 0s. 0d.; 96/98 per cent., £269 0s. 0d.

Ferro-columbium.—60/75 per cent., Nb + Ta, 28s. per lb., Nb. + Ta.

Ferro-manganese (home).—78 per cent., £54 10s. 0d.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms, and Slabs.—BASIC: Soft, u.t., £26 19s. 0d.; tested, 0.08 to 0.25 per cent. C, £27 19s. 0d.; hard (0.41 to 0.60 per cent. C), £29 5s. 6d.; silico-manganese, £37 12s. 6d.; free-cutting, £31 0s. 6d. SIEMENS MARTIN ACID: Up to 0.25 per cent. C, £34 12s. 0d.; silico-manganese, £36 12s. 6d.

Billets, Blooms, and Slabs for Forging and Stamping.—Basic, soft, up to 0.25 per cent. C, £32 11s. 0d.; basic, hard, over 0.41 up to 0.60 per cent., C, £33 13s. 6d.; acid, up to 0.25 per cent. C, £36 12s. 6d.

FINISHED STEEL

Heavy Plates and Sections.—Ship plates (N.-E. Coast), £33 1s. 6d.; boiler plates (N.-E. Coast), £35 11s. 6d.; floor plates (N.-E. Coast), £34 10s. 6d.; sectional material, N.-E. Coast, £30 19s. 6d.

Small Bars, Sheets, etc.—Rounds and squares, under 3 in., untested, £34 7s. 0d.; flats, 5 in. wide and under, £34 7s. 0d.; hoop and strip, £35 1s. 6d.; uncoated strip mill coils, hot rolled, under 3mm. to 12g., £36 5s. 0d.; black sheets (hand mill), 17/20 g., £46 13s. 6d.; galvanized corrugated sheets, 24 g., £58 11s. 0d.

Alloy Steel Bars.—1 in. dia. and up: Nickel, £58 0s. 3d.; nickel-chrome, £81 10s. 0d.; nickel-chrome-molybdenum, £92 7s. 6d.

NON-FERROUS METALS

Copper.—Cash, £398 0s. 0d. to £399 0s. 0d.; three months, £393 0s. 0d. to £394 0s. 0d.; settlement, £399 0s. 0d.

Copper Tubes, etc.—Solid-drawn tubes, 3s. 9½d. per lb.; rods, 443s. 9d. per cwt. basis; 20 s.w.g., 470s. 6d. per cwt.

Tin.—Cash, £828 0s. 0d. to £830 0s. 0d.; three months, £807 0s. 0d. to £808 0s. 0d.; settlement, £830 0s. 0d.

Lead (Refined Pig).—Second half December, £115 15s 0d. to £116 0s. 0d.; second half March, £115 0s. 0d. to £115 15s. 0d.

Zinc.—Second half December, £99 5s. 0d. to £99 10s. 0d.; second half March, £97 5s. 0d. to £97 10s. 0d.

Zinc Sheets, etc.—Sheets, 15 g. and thicker, all English destinations, £130 10s. 0d.; rolled zinc (boiler plates), all English destinations, £128 5s. 0d.; zinc oxide (Red Seal), d/d buyers' premises, £109 0s. 0d.

Brass Tubes, etc.—Solid-drawn tubes, 2s. 11¾d. per lb.; rods, drawn, 3s. 9d.; sheets to 10 w.g., 373s. 0d. per cwt.; wire, 3s. 6⅝d.; rolled metal, 358s. 9d. per cwt.

Brass (Brazing).—BS1400, B3 (65/35), £239; B6 (85/15), —; BS249, —

Brass (High Tensile).—BS1400, HTB1 (30 tons), £298; HTB2 (38 tons), £300; HTB3 (48 tons), —.

Gunmetal.—BS1400, LG2 (85/5/5/5), £340; LG3 (86/7/5/2), £348; G1 (88/10/2/½), £422; (88/10/2/1), £410.

Phosphor Bronze.—BS1400, PB1 (AID released), £435 per ton.

Phosphor Bronze Strip, etc.—Strip, 523s. 9d. per cwt.; sheets to 10 w.g., 547s. 3d. per cwt.; wire, 5s. 4½d. per lb.; rods, 4s. 8½d.; tubes, 4s. 6¾d.; chill cast bars: solids 4s. 8½d., cored 4s. 9½d. (CHARLES CLIFFORD, LIMITED).

Nickel Silver, etc.—Rolled metal, 3 in. to 9 in. wide × 0.056, 4s. 6d. per lb.; round wire, 10g. in coils (10 per cent.), 4s. 10½d.; special quality turning rod, 10 per cent., ½ in. dia., in straight lengths, 4s. 9½d. All prices are net.

Other Metals.—Magnesium, ingots, 2s. 4d. per lb. Antimony, English, 99 per cent., £210 0s. 0d. Quicksilver, ex-warehouse, £89 0s. 0d. to £89 10s. 0d. Nickel, £519 0s. 0d. Aluminium ingots, £171 0s. 0d.; aluminium bronze (BS1400), AB1, £379; AB2, £390. Solder, brazing, BS1945, 3s. 1d. lb.; granulated, 3s. 4½d. lb.

* Average 68-70 per cent.

Forthcoming Events

JANUARY 3

Institution of Works Managers

Leicester branch:—"Human Relations," by Mrs. J. H. M. Booth, M.A. Joint meeting with Notts and Derby branch (details from the secretary).

Institution of Production Engineers

Southern region, Oxford section:—"Cost Accounting as an Aid to Efficient Production," by H. J. Furness, 7.15 p.m. at the Town Hall. Joint meeting with the Oxfordshire Sub-branch of the Institute of Cost & Works Accountants.

Institute of Metals

Oxford local section:—"Patents," by T. M. Connelly. B.Sc., 7 p.m., in the Ballroom of the Cadena Cafe, Cornmarket Street.

JANUARY 4

Incorporated Plant Engineers

Southern branch:—"Costing and Accountancy in Relation to Plant Engineering, including Explanation of Balance Sheets," by S. J. Clark, F.S.A.A., 7.30 p.m., at the Polygon Hotel, Southampton.

Institute of Fuel

London meeting:—"Some Coal Research Problems and their Industrial Implications," by R. L. Brown, 5.30 p.m., at the Institution of Civil Engineers, Great George Street, S.W.1.

JANUARY 5

Institute of Metals

Birmingham local section:—"Recent Developments in Foundry Practice," by D. V. Atterton, Ph.D., M.A., 6.30 p.m., at the James Watt Memorial Institute, Great Charles Street.

Incorporated Plant Engineers

Peterborough branch:—"Factory Flooring Problems," 7.30 p.m. at the Campbell Hotel, Bridge Street.

Institution of Production Engineers

Southern section:—"Economic and Social Effects of Automation," by R. R. Williams, 7.30 p.m., at Southampton University. Members of the Southern section will be guests of the Institute of Plastics.

JANUARY 7

Institute of British Foundrymen

West Riding of Yorkshire branch:—"Use of Refractories in the Foundry," by W. E. Ambler, 6.30 p.m., at the Technical College, Bradford.

Institution of Production Engineers

Liverpool graduate section:—Works visit to ICI Limited, Metals Division, Kirkby Works.

Changes of Name

Among companies which have recently changed their names are those listed below. The new titles are given in parentheses.

COLIN BARRALET, LIMITED, 58, Lee Church Street, London, S.E.13 (Barralets Heaters, Limited).

TEES FOUNDRIES, LIMITED, 20/26, Northgate, Darlington (Pease & Partners Tees Foundries, Limited).

B. & I. ENGINEERING, LIMITED, Sicilian House, Sicilian Avenue, London, W.C.1 (I. B. Fisher, Limited).

TRAFFORD PARK STEEL WAREHOUSE, LIMITED, Tenax Road, Trafford Park, Manchester (Trafford Park Steel, Limited).

SPARSHOTTS ELECTRICAL ENGINEERING COMPANY, LIMITED, 119, Bargates, Christchurch, Hants (Keeping's Electrical, Limited).

BARLOW & CHIDLAW, LIMITED, gear and wheel cutters and manufacturers, etc., of Grafton Street, Pendleton, Manchester (Barlow & Chidlaw (Residuary), Limited).

BARLOW & CHIDLAW HOLDINGS, LIMITED, gear and wheel cutters and manufacturers, etc., of Grafton Street, Pendleton, Manchester (Barlow & Chidlaw, Limited).

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BIRMINGHAM, 2. 39, Corporation St., Midland 3375/6
LIVERPOOL, 2. 13, Rumford St., Central 1558
GLASGOW, C.2. 93, Hope Street, Central 9969

CLASSIFIED ADVERTISEMENTS

PREPAID RATES: **Fifteen words for 7/6 (minimum charge) and 4d. per word thereafter. Box Numbers 2/6 extra (including postage of replies.) Situations Wanted 2d. per word.**

Advertisements (accompanied by a remittance) and replies to Box Numbers should be addressed to the Advertisement Manager, Foundry Trade Journal, John Adam House, 17/19, John Adam Street, Adelphi, London, W.C.2. If received by first post Monday advertisements can normally be accommodated in the following Thursday's issue.

SITUATION WANTED

CASTING SALES REPRESENTATIVE, iron and non-ferrous, requires appointment for district in Essex, Hertfordshire, Outer London.—Box CS717, FOUNDRY TRADE JOURNAL.

SITUATIONS VACANT

The engagement of persons answering these advertisements must be made through a Local Office of the Ministry of Labour or a Scheduled Employment Agency if the applicant is a man aged 18-64 *inclusive or a woman aged* 18-59 *inclusive unless he or she, or the employment, is excepted from the provisions of the Notification of Vacancies Order,* 1952.

STEEL FOUNDRY MANAGER required for South Wales Steel Foundry making Steel Castings up to 2 tons in weight. The steel foundry and its allied departments, i.e., laboratories, methods' study, etc., are in final process of reorganisation. New buildings, including a laboratory, are part of this reorganisation. Output, at present 50 tons of finished castings per week, is to be increased. Applicants must have held similar position, and be possessed of above-average ability. There is a staff pension scheme, and the salary will be commensurate with the responsibility this appointment carries.—Please reply in confidence to BROWN LENOX & CO., LTD., Pontypridd, Glamorgan, marked for the attention of Mr. A. G. Gilbertson, giving full information about previous experience.

ALLIED IRONFOUNDERS, LTD., invite applications for the appointment as METALLURGIST/CHEMIST at their Greenford Plant, with drive, sound practical and theoretical knowledge, to take charge of large melting department. Wide experience in modern cupola operations, stock yard, charge materials, laboratory control of raw materials, routine chemical analysis of metal, sand control, etc. Permanent post for right man, pension scheme. Must have completed term of National Service.—Applications, which will be treated as confidential, giving fullest information, to SECRETARY, British Bath Co., Ltd., Greenford, Middx.

BROWN, LENOX & CO., LTD., have the following vacancies in their Steel Foundry:—

(1) SHIFT CHEMIST, to control steel making on Basic Electric Arc Furnaces.

(2) TECHNICAL ASSISTANT for Sand Control.

Applicants with training in similar metallurgical fields will be considered.—Write, giving details of experience, qualifications, age, etc., to the WORKS METALLURGIST, Brown, Lenox & Co., Ltd., Pontypridd, Glam.

PATTERNMAKER ASSISTANT FOREMAN required, permanent staff position, used to production of first-class metal pattern equipment. A good Estimator and Checker, capable of doing all under-foreman's duties.—WRIGHT & PLATT LTD., The World's Largest Engineering Master Patternmakers, Irving Street, Birmingham.

SITUATIONS VACANT—*contd.*

IRON MOULDER wanted. First-class work. P.W. high guaranteed rate.—MOYLE, Kingston-on-Thames.

PATTERN DRAUGHTSMEN required for designing drawings, first-class wood/metal Pattern Equipment. Excellent conditions including canteen (main meals, etc.).—WRIGHT & PLATT LTD., The World's Largest Engineering Master Patternmakers, Irving Street, Birmingham.

METAL PATTERNMAKERS required, used to production of first-class metal Pattern Equipment. Top wages, excellent conditions including canteen (main meals, etc.), music while you work and full overtime.—WRIGHT & PLATT LTD., The World's Largest Engineering Master Patternmakers. Irving Street, Birmingham.

REPRESENTATIVE (35/40) required to sell non-ferrous centrifugal castings. Engineering training or background required. Must be able to negotiate at high level. Good remuneration and prospects for first-class man.—Write METALS & ALLOYS LTD., Minworth, Birmingham.

PATTERN MAKER required for small progressive non-ferrous Foundry in the Bristol area. Good knowledge of Metal Match Plate and loose pattern work. Able to take charge and work on own initiative. Write, giving details of experience, etc., to Box PM 704, FOUNDRY TRADE JOURNAL.

FOUNDRY FOREMAN required for Modern Semi-Mechanised Brass-foundry in the Birmingham area. Applicants must have practical and technical knowledge in the production of Brass and Gun Metal Castings, and possess knowledge of Core-Blowing equipment. Excellent position for the right person.—Write, giving full details and copies of testimonials, Box FF715, FOUNDRY TRADE JOURNAL.

SALES ENGINEER required by leading firm specialising in all aspects of Foundry Mechanisation. Must have sound foundry training in addition to Mechanical Handling experience. To operate from London headquarters.—Apply, giving full particulars and stating salary required, to Box SE718, FOUNDRY TRADE JOURNAL.

FOUNDRY TECHNICIAN AND METALLURGIST required for Newcastle-upon-Tyne Bronze and Aluminium Foundry. Expert knowledge of melting processes and general non-ferrous foundry techniques, including shell mouldings, needed. Age about 30. Applicants should give details of education, experience, and salary required.—Box FT719, FOUNDRY TRADE JOURNAL.

FOUNDRY FOREMAN required, to control Jobbing Foundry in Wednesbury district, producing grey iron castings ranging from 2 lbs. to 5 tons in weight.—Apply, giving full particulars of previous experience, stating age and salary required, to Box FF720, FOUNDRY TRADE JOURNAL.

SITUATIONS VACANT—*contd.*

HEAD FOREMAN required, to control Steel Foundry Dressing Shops producing wide range of carbon and alloy steel castings. Experience in this field is desirable, although engineering shop background in, say, fabrications, would be considered.—Replies, giving details of experience to date, and salary required, to CATTON & CO., LTD., Chadwick Street, Leeds, 10.

A STEEL FOUNDRY in Calcutta (India) requires the services of Two Foundry Experts. The Foundry produces, at present, 400 tons of steel castings per month, consisting of rolling stock castings, industrial maintenance castings, etc. Manganese steel castings are also produced. The Foundry is partly mechanised and partly jobbing. Both green and dry sand methods are used. The qualifications and the experience required are indicated below:—

FOUNDRY ENGINEER: The applicant must have thorough knowledge of modern Steel Foundry practices and Foundry Mechanisation. Must be capable of improving methods and rationalising production. Knowledge of operation of modern Foundry Machines, production control, quality control with special reference to sand control, essential. The introduction of unit sand system is intended, and the applicant should have knowledge of how to introduce such system. Experience in similar capacity in any large Steel Foundry essential.

FOUNDRY PRODUCTION MANAGER: The applicant must have practical knowledge of moulding, core-making and pattern-making and heat-treatment of steel castings. A very thorough knowledge of sand mixtures for both green sand and dry sand work in Steel Foundry essential. Will be required to guide estimates preparation. Previous practical experience in similar situation essential.

Remuneration: Rs.2,500 per month for first post and Rs.2,000 per month for second post, subject to Indian income-tax.

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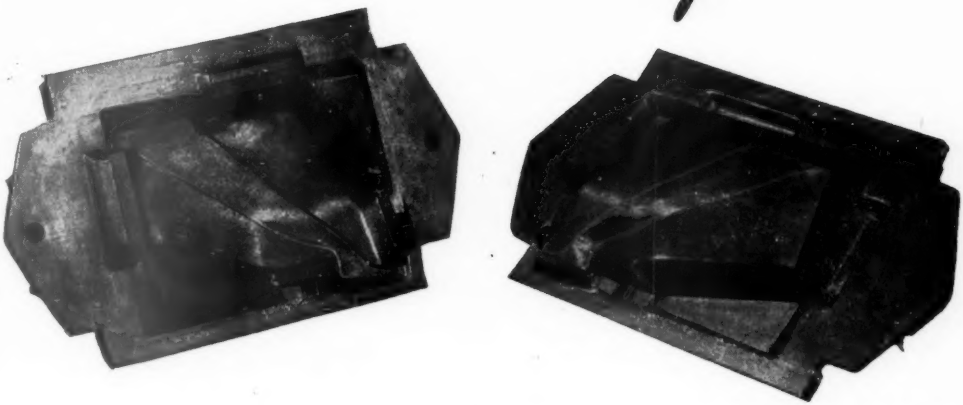

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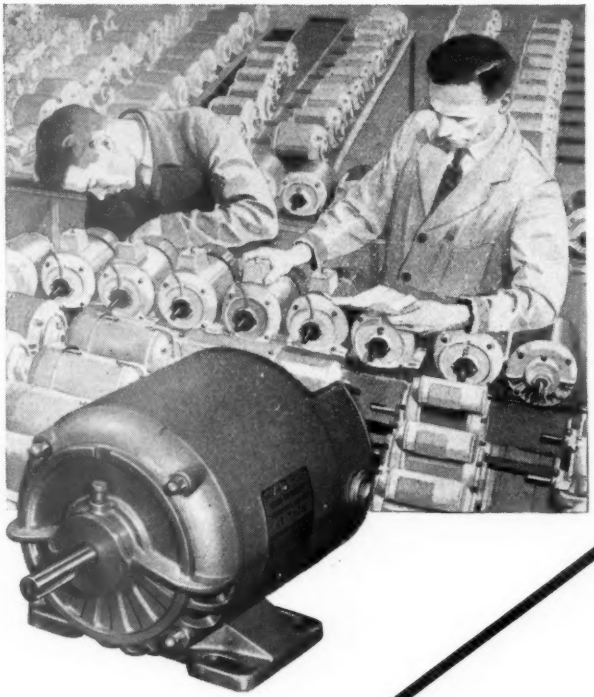

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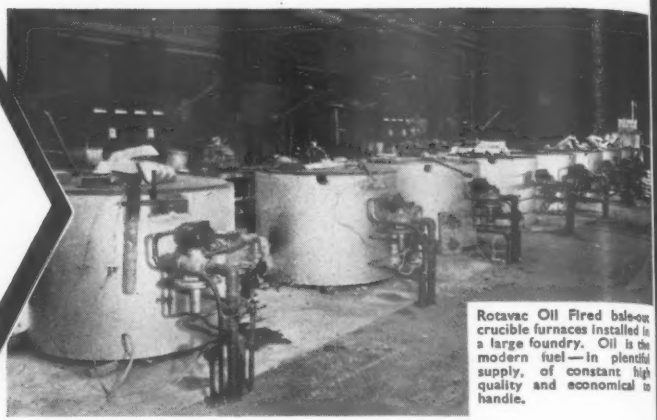

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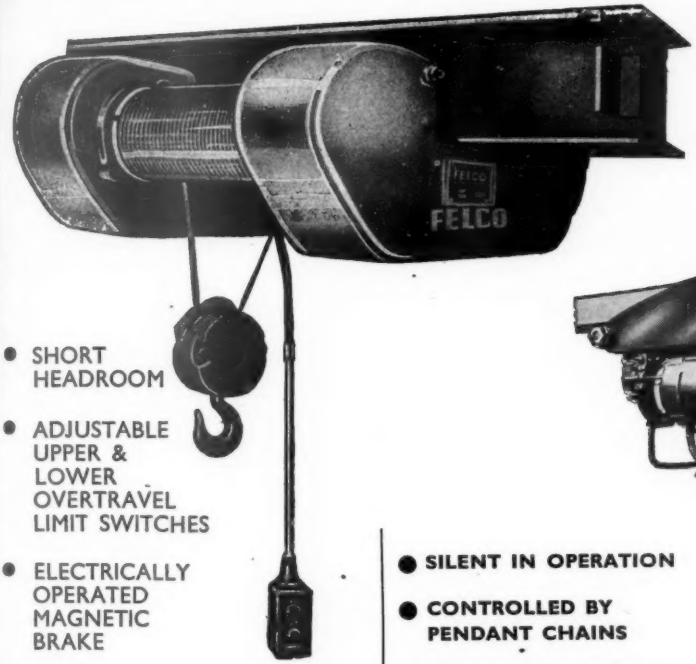

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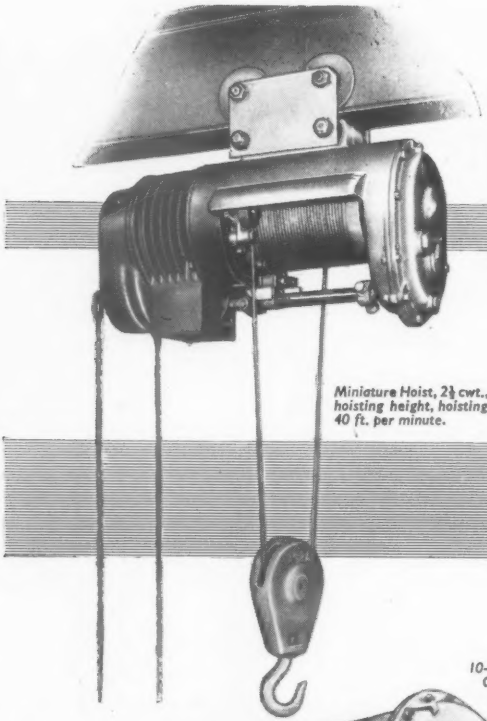

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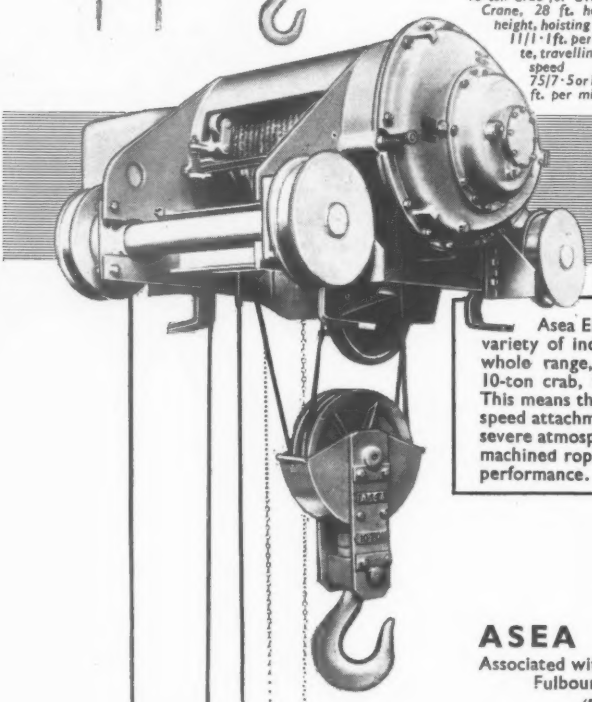

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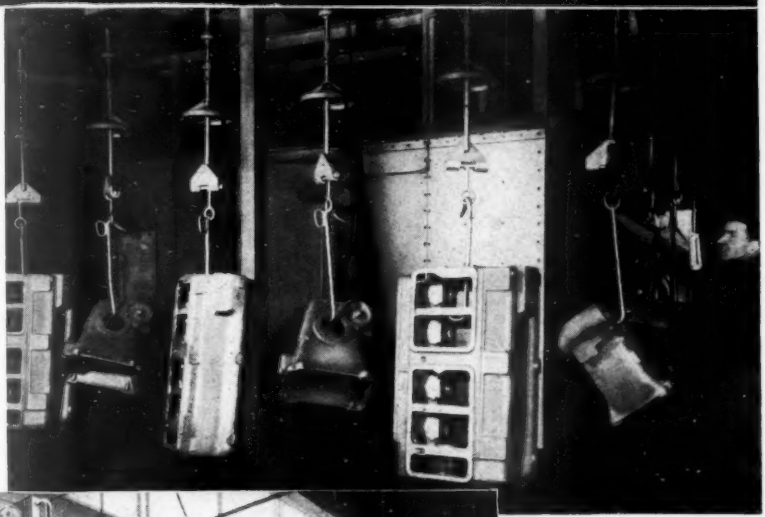
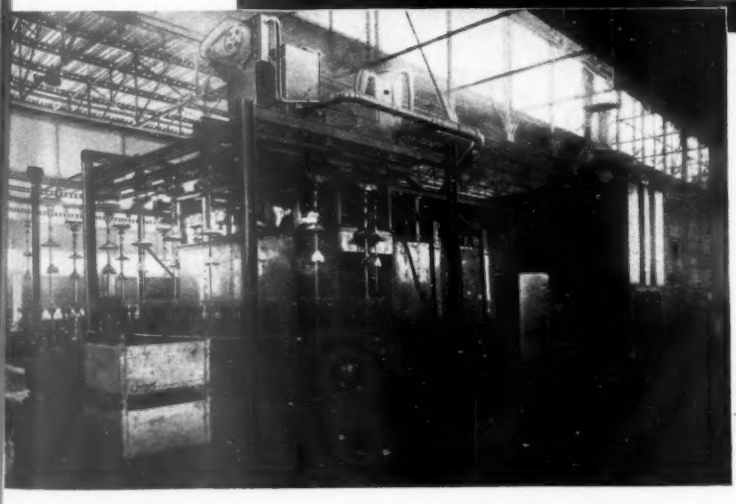
Three-wheel monorail conveyor installation

Illustration shows plant used for cleaning engine crank cases weighing up to 1 cwts. each.





four-wheel monorail conveyor Wheelabrator

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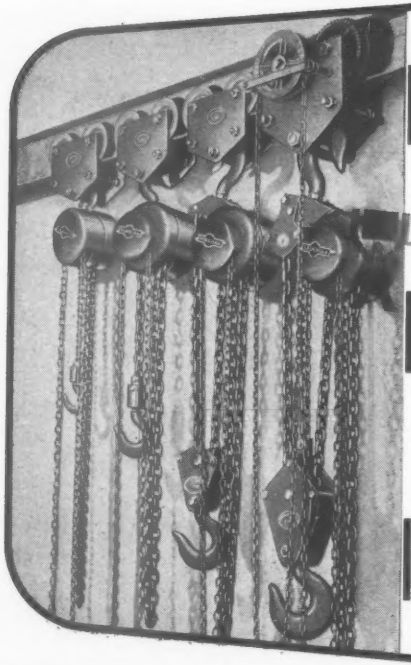

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P.702/E

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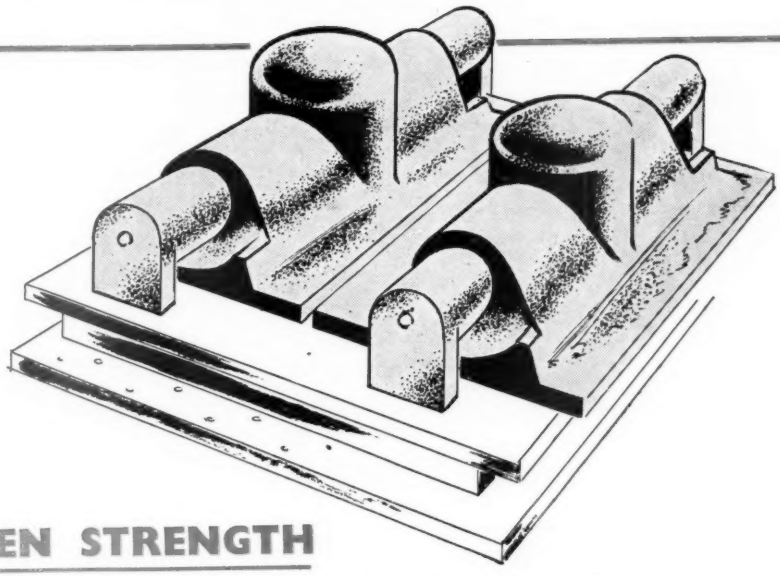

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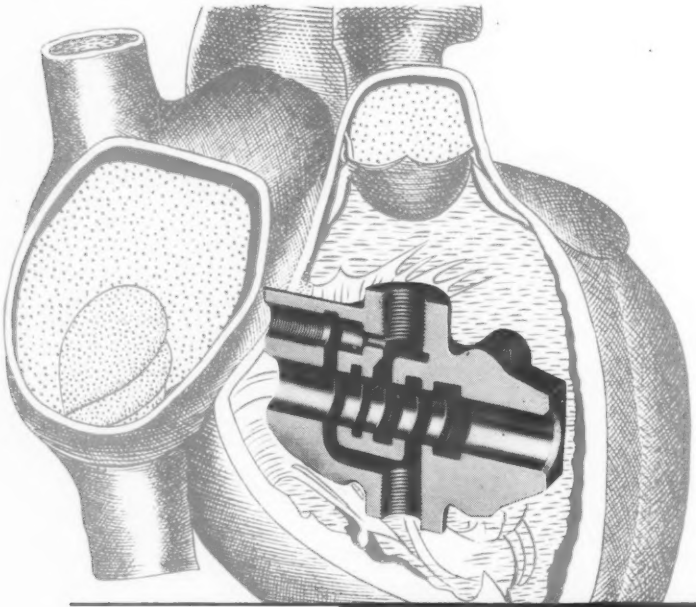

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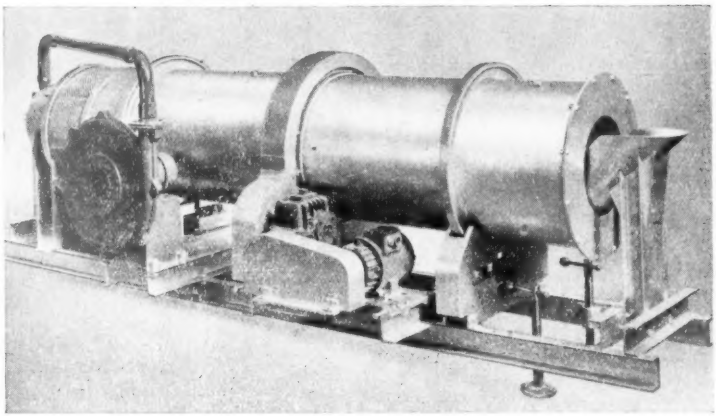

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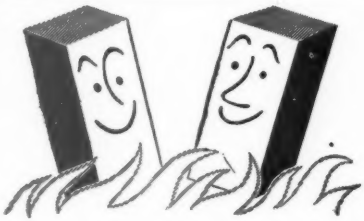

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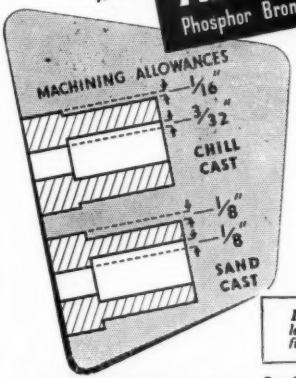

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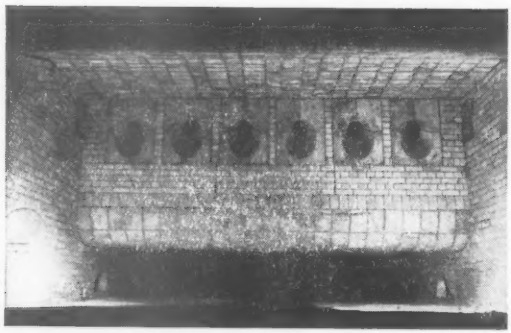
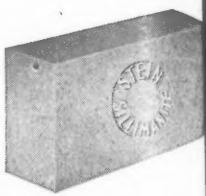


With kind acknowledgment to Steel Company of Scotland, Ltd. & Priest Furnaces, Ltd., Middlesbrough.



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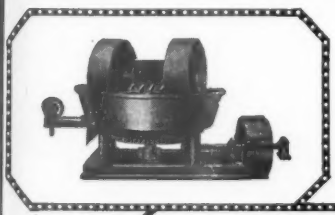

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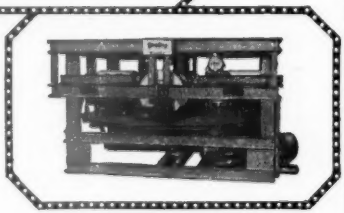
5 to 40 tons per hour



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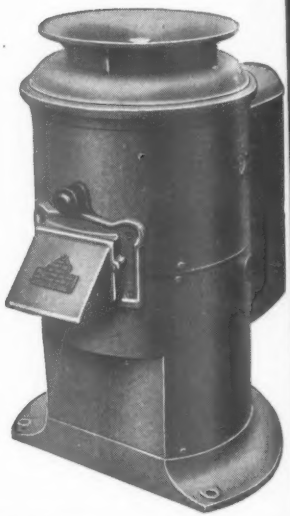

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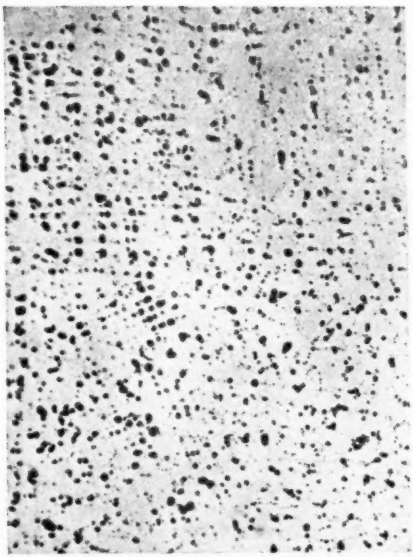

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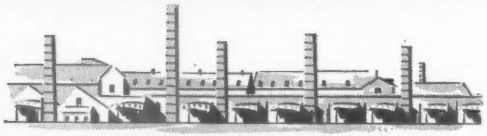

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